ForeView™ VLAN Manager User's Manual

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Software Version 4.3

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Legal Notices

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Preface

The intent of this manual is to supply users of the *ForeView*™ VLAN Manager software with all the necessary information to successfully install and operate this software package. This document was created for users with various levels of experience. If you have any questions or problems with the installation, please contact FORE Systems' Technical Support.

Chapter Summaries

Chapter 1 - Introduction - Provides an overview of the capabilities of the VLAN Manager package, as well as information about supported hardware and software platforms.

Chapter 2 - LAN Emulation and MPOA Overview - Provides an explanation of the components that make up LAN Emulation (LANE) and Multi-Protocol Over ATM (MPOA), and walks you through the operation of an emulated LAN.

Chapter 3 - Quick Start Guide to VLAN Manager - Provides a guide for starting to use VLAN Manager, including pre-requisites, start commands, using VLAN Manager with pre-existing configurations or with a new domain, and an example showing configuration of ELANs in a simple network.

Chapter 4 - Using the VLAN Manager Interface - Provides information about the layout and use of the VLAN Manager's user interface, menu overviews, and information about the correct use of a mouse to facilitate the drag-and-drop functionality of the VLAN Manager.

Chapter 5 - Using the Toolbar Functions - Provides information about the VLAN Manager functions: Sync, Commit, Diff, Find, and Poll.

Chapter 6 - Configuring VLANs and Members - Explains how to create and modify domains, VLANs and members,.

Chapter 7 - Editing VLAN Properties - Explains how to modify VLAN properties and maintain LANE services.

Appendix A - Modifying a FV 4.x LECS Configuration File - Contains instructions and examples on how to edit an existing LECS file (that is compatible with earlier versions of the VLAN Manager) so that existing network configurations can be opened in the new VLAN Manager.

Technical Support

In the U.S.A., customers can reach FORE Systems' Technical Assistance Center (TAC) using any one of the following methods:

1. Select the "Support" link from FORE's World Wide Web page:

   http://www.fore.com/

2. Send questions, via e-mail, to:

   support@fore.com

3. Telephone questions to "support" at:

   800-671-FORE (3673) or **724-742-6999**

4. FAX questions to "support" at:

   724-742-7900

Technical support for customers outside the United States should be handled through the local distributor or via telephone at the following number:

+1 724-742-6999

No matter which method is used to reach the TAC, customers should be ready to provide the following:

- A support contract ID number
- The serial number of each product in question
- All relevant information describing the problem or question

Typographical Styles

Throughout this manual, specific commands to be entered by the user appear on a separate line in bold typeface. In addition, use of the `Enter` or `Return` key is represented as `<ENTER>`. The following example demonstrates this convention:

`cd /usr <ENTER>`

Commands or file names that appear within the text of this manual are represented in the following style: "...the **`fore_install`** program will install this distribution"

As in the following example, any messages appearing on your screen during software installation and network interface administration will appear in `Courier` font to distinguish them from the rest of the text.

```
.... Are all four conditions true?
```

Important Information Indicators

To call your attention to safety and otherwise important information that must be reviewed to insure correct and complete installation, *NOTE* indicator.

NOTE statements contain information that has been found important enough to be called to the special attention of the operator and will be set off from the text as follows:

If you have retrieved a software file with a .tar extension, do NOT untar it. The **`operation upgrade`** command in the ATM Management Interface (AMI) will expect the upgrade file to be in tarfile format.

CHAPTER 1 Introduction

VLAN Manager is a graphical tool for remote management of virtual LANs (VLANs) spanning ATM networks and legacy LANs. The VLAN Manager graphical user interface (GUI) provides a powerful and convenient way for novice and expert network administrators to manage VLANs. A VLAN is a logical collection of network devices grouped into a single broadcast domain. It is not dependent on the physical location of the device but can be organized as desired by the network administrator.

1.1 Types of VLANs

VLAN Manager allows you to easily manage:

- *Emulated LANs (ELANs)* operating within the ATM cloud. An ELAN is a collection of devices running on the ATM network, interacting to emulate an Ethernet or Token Ring LAN. The ELAN components resolve MAC addresses to ATM addresses, replace the connectionless operation of legacy LANs with point-to-point connections, and provide broadcast and multicast services.
- *IEEE 802-style VLANs* operating on FORE's ES-3810. An 802-style VLAN consists of hosts attached to the ES-3810 edge device. You can specify which hosts attached to the member devices are grouped into a single broadcast domain. 802-style VLANs can be Port-based, Port and MAC-based, or MAC-based:
  - In Port-based VLANs, ports on each edge device are specified to determine which hosts attached to the edge device are members of the VLAN.
  - In Port and MAC-based VLANs, ports are specified on each edge device and MAC addresses can be specified at the VLAN level to determine which hosts attached to the edge device are members of the VLAN.
  - In MAC-based VLANs, MAC addresses are specified at the VLAN level to determine which hosts attached to the edge device are members of the VLAN.
- *Hybrid VLANs*, which include ELANs and 802-style VLANs. A hybrid VLAN is maintained within VLAN Manager as a way to organize ELANs and 802-style VLANs into a single broadcast domain. A proxy LEC (refer to "Proxy LAN Emulation Client (Proxy LEC)" on page 2-3 for a description) running on the ES-3810 provides connectivity from the 802-style VLAN to the ELAN.

1.2 Required Knowledge

VLAN Manager is designed based on the assumption that the user understands the concepts of traditional computer networking. A basic knowledge of LAN Emulation (LANE), Multi-Protocol Over ATM (MPOA) and virtual LANs is very helpful. Refer to "LAN Emulation and MPOA Overview" on page 2-1 for an introduction to LANE and MPOA.

1.3 New *ForeView* Configuration File Resources

ForeView 5.0 VLAN Manager takes advantage of four new resources that you can configure in the ForeView configuration file

fvlanPollAfterOpen	Sets the default action for whether VLAN Manager should poll a domain after the domain is opened in the GUI. If this resource is not used, VLAN Manager will poll the domain by default.
<domain>.fvlanAutoDetectNSAP AddrChanges	Sets the default action for whether VLAN Manager should automatically attempt to detect NSAP address changes during polls. If this resource is not used, VLAN Manager will detect the NSAP changes by default.
<domain>.fvlanAutoCreateMPC	Sets the default action for whether VLAN Manager should automatically create MPCs when creating ELAN members (LECs) on ES-3810s. If this resource is not used, VLAN Manager will create the MPCs by default.
<domain>.fvlanAutoSave EdgeDeviceCfg	Sets the default action for whether VLAN Manager should automatically save the configuration for the FORE ES-3810 after a Commit function has been performed that affects the edge device configuration. If this resource is not used, VLAN Manager will save the configurations by default.

fvlanMgmtVLANsELANs Specifies VLANs that are used by the management station for connectivity. If you perform a Commit operation that will affect connectivity with the VLANs specified in this parameter, VLAN Manager will warn you. If this resource is not used, VLAN Manager will poll prompt you for management VLANs when it starts up.

For more information on editing the *ForeView* configuration file, refer to the *ForeView Network Management User's Guide*.

1.4 Installing VLAN Manager

Save your existing configuration to a local file before installing the new VLAN Manager. See "Creating a Local Backup File" on page A-5 for information on saving a local file.

VLAN Manager is installed as a patch to your existing *ForeView* installation. Refer to the release notes, included with this VLAN Manager software for information on installation.

1.5 Capabilities Overview

This version of VLAN Manager does not support *PowerHub* edge devices. Any *PowerHub* devices in your network must be managed manually. VLAN Manager will not accept a configuration file that includes *PowerHub* devices.

VLAN Manager includes the following features:

- Creation and modification of VLANs through a GUI:
  - VLAN Manager creates or modifies a VLAN configuration, and graphically displays the VLAN configurations contained in the file. This eliminates tedious manual editing of the configuration file and avoids the possibility of errors in typing or syntax.

  - As you make changes through VLAN Manager, the changes aren't actually made until you explicitly perform a Commit function. As members are added and deleted from VLANs, the visual representation of the VLAN configuration changes, allowing the system administrator to visualize the final network without having to commit the changes.
  - You can use the mouse to drag and drop member icons into VLAN icons, allowing easy changes to VLAN membership.
  - Simple one-button operation of Commit and Synch features from a toolbar.
- VLAN Status Monitoring through the GUI:
  - Quick at-a-glance display of VLAN and domain status through color-coded icons. Domain, VLAN, and services icons display a status that is an aggregate of the status of their members.
  - Effective and efficient method of monitoring the status of a VLAN through a configurable polling function.
  - A common interface for obtaining network information, and presents the status of various virtual LANs and members using a color code.
  - Changes in NSAP address (due to a device changing its switch port) are automatically determined.
  - Conflicts between the VLAN Manager view and the actual network are discovered through the Sync function.

- Remote handling of the LAN Emulation Services through a GUI:
  - VLAN configuration changes are shown on the GUI, and, when you perform a Commit, configuration files of remote machines are updated using a file transfer mechanism. In addition, VLAN manager updates the configuration of ES-3810 access devices.
  - LANE services (the LECS and LES-BUS pairs) are easily started and stopped through the GUI. You don't have to manually enter the commands on the machines where the services are running.
  - Additional Distributed LAN Emulation peer services (LES-BUS pairs) are easily added and removed through the GUI.
  - The selector byte used by the services is easily monitored.
  - You can easily specify IP flow parameters to provide QoS to legacy applications.
  - The GUI avoids the complex procedures and syntax for starting and stopping services.
  - Through polling, VLAN Manager discovers active clients that are members of ELANs that VLAN Manager is aware of but were not configured by VLAN Manager.
- 802-style VLAN Support:
  - VLAN Manager also allows the network administrator to create VLANs across ATM and legacy LANs connected via ES-3810 edge devices.
  - A LEC on the edge device can act as a proxy for the non-ATM members of the 802-style VLAN, allowing a "hybrid" VLAN with ATM and non-ATM members.
  - 802-style VLANs can determine end-host membership based on port number, MAC address, or port and MAC address.

A LAN emulation client (LEC) can exist in only one VLAN. VLAN Manager will not "copy" a LEC instance into another emulated LAN.

1.6 System Requirements

Before installing VLAN Manager software, be sure you have a platform which meets the following requirements. You will need to have the root password for the machine on which you wish to install the software.

1.6.1 Hardware

System: Sun

- SPARCstation (SPARCstation 10 Recommended)
- Ethernet, ATM SBA-200E or SBA-200 Network Interface (SBA-200E required for MPOA)
- Color monitor
- Free Disk Space: 32MB (minimum)
- Swap Space (Stand-alone): 64MB (minimum)
- Swap Space (OV, SNM): 96MB (minimum), 128 (recommended)
- Memory: 32MB (minimum) (64 MB recommended)

System: PC

- IBM-compatible PC with a Pentium CPU (200 MHz or faster recommended)
- Ethernet or ATM PCA-200EPC or *ForeRunnerLE* Network Interface
- Color monitor (1024 x 768, 256 colors)
- Free Disk Space: 100MB (minimum)
- Memory: 64MB (minimum)
- Mouse required, Microsoft or Logitech compatible

1.6.2 Software

System: Sun

- Solaris 2.5 or 2.6
- Netscape Navigator 3.x or 4.x

System: PC

- Microsoft Windows NT 4.0

NOTE

The user's file system must support long file names.

- Netscape Navigator 3.x or 4.x or Microsoft Internet Explorer (MSIE) 3.0 or 4.0 (See Release Notes for information on MSIE performance under Windows NT.)

1.7 On-line Help

VLAN Manager provides an on-line Help manual in HTML format to assist you during network management tasks. You can get on-line help by clicking on the Help buttons found on the dialogs or by selecting the Contents option of the Help menu. A display similar to Figure 1.1 provides help related to the task you are performing.

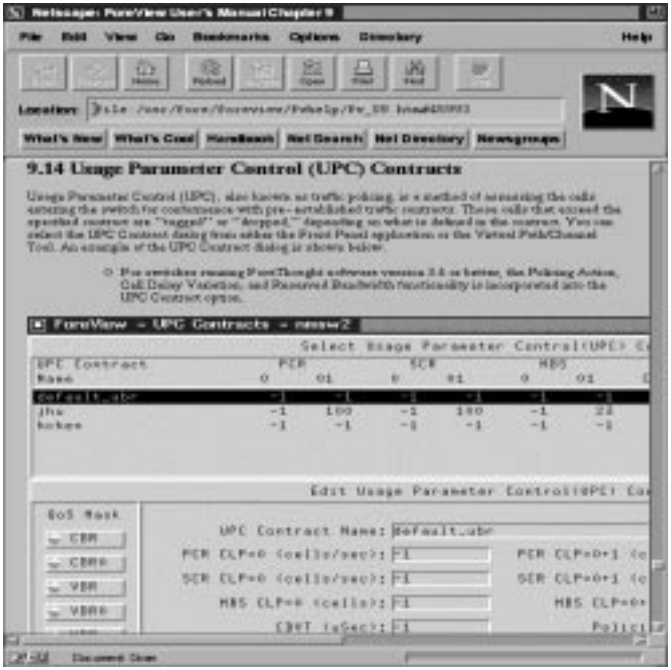


Figure 1.1 - On-line Help Example

1.8 Unpacking Information

Upon receipt of, and before opening, your software, inspect the package for any damage that may have occurred during shipping. If the package shows any signs of external damage or rough handling, notify your carrier's representative.

When unpacking the software be sure to keep all original packing materials. They may be needed for return of the product.

CAUTION

All products returned to FORE Systems, under warranty, must be packed in their original packing materials.

CHAPTER 2 LAN Emulation and MPOA Overview

This chapter provides an overview of the LAN Emulation (LANE) and Multi-Protocol Over ATM (MPOA) components and describes how an Emulated LAN (ELAN) functions over an ATM network. LANE is a set of software functions providing emulated services similar to the broadcast environment of conventional LAN technology. Because LANE is protocol-independent, it allows existing applications and protocols to operate over ATM backbones. MPOA is a set of additional functions that avoid the significant transmission delays imposed by routers in a LANE network.

An ELAN, which is a subset of LANE, is a logical grouping of devices into a common user group that is able to exchange similar types of data frames within the same broadcast domain, similar to a physical LAN. One or more ELANs may run simultaneously (and independently) on the same ATM network. Just as with physical LANs, communication between ELANs is possible only through routers or bridges.

Each ELAN is composed of the following components:

- LAN Emulation Clients (LECs)
- LAN Emulation Configuration Server (LECS)
- LAN Emulation Server (LES) and Broadcast and Unknown Server (BUS)

An MPOA ELAN also includes:

- Multi-Protocol Server (MPS)
- Multi-Protocol Client (MPC)

Each LEC and MPC resides in an ATM host system (PC, Unix workstation, or bridge device such as a FORE Systems ES-3810). In the current software release, the LECS and each LES-BUS pair can reside on one of the following devices:

- *ForeRunner* switch
- Unix workstation running *ForeThought* version 5.0.x supporting Solaris
- ASN-9000 running *ForeThought* version 5.0.x

Additional software features include intelligent BUSs, and the use of multiple LES-BUS pairs to provide Distributed LAN Emulation (DLE), giving redundant LES and BUS support to an ELAN.

2.1 Emulated LAN Components

The components of an emulated LAN include LAN Emulation Clients (LECs), proxy and non-proxy; and LAN Emulation Services consisting of:

- a LAN Emulation Configuration Server (LECS)
- a LAN Emulation Server (LES)
- a Broadcast and Unknown Server (BUS)

Each of these services may reside on the same service host or on different service hosts, although the LES and BUS should run on the same host. For example, the LECS could reside on an FORE ATM switch control processor (SCP), while the LES and BUS reside on a workstation. The functional interconnections of a simple ELAN consisting of a LEC, a proxy LEC, an LECS, LES, and BUS are shown in Figure 2.1.

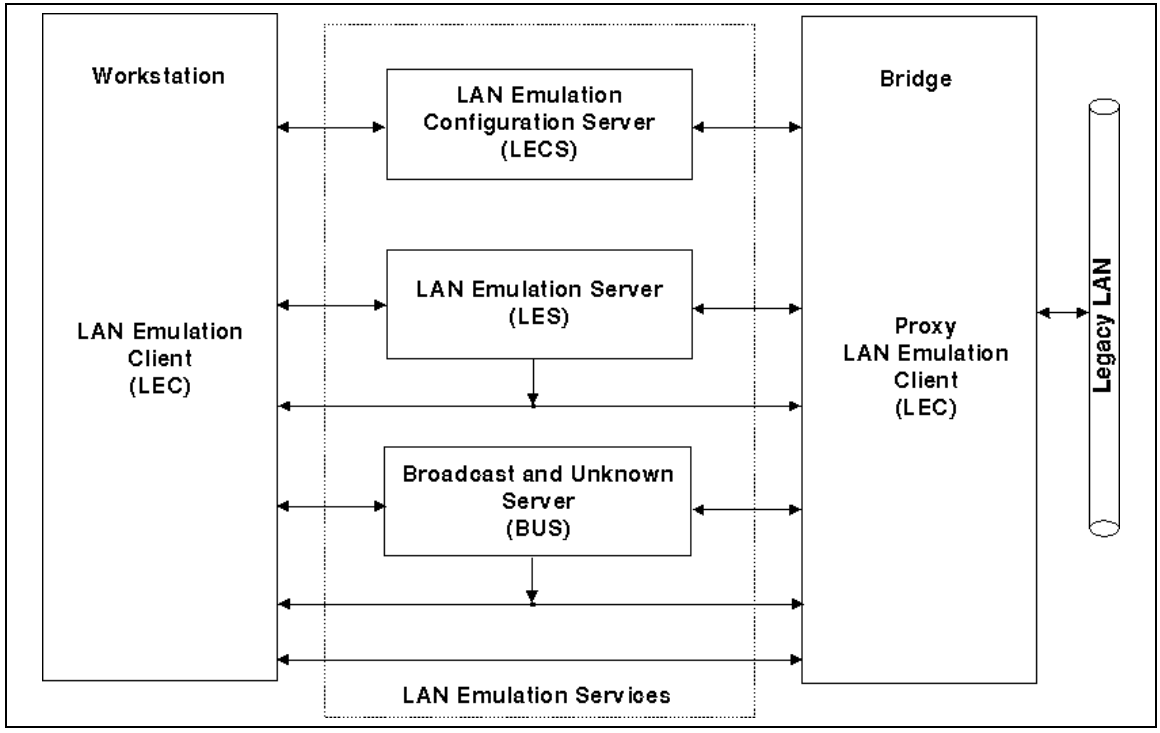


Figure 2.1 - Basic Emulated LAN Interconnections

2.1.1 LAN Emulation Client (LEC)

The LEC is the component in an end system or edge device (see Proxy LEC) that performs data forwarding, address resolution, and other control functions when communicating with other components within the ELAN. It also provides a MAC level emulated Ethernet or Token Ring interface and appears to higher level software to be a physical Ethernet or Token Ring interface. Each LEC must register with both the LES and BUS associated with the ELAN it wishes to join before it can participate in the ELAN.

2.1.2 Proxy LAN Emulation Client (Proxy LEC)

A proxy LEC is a special LEC that joins the ELAN "in proxy" for other stations. The most common example of a proxy LEC would be a ES-3810 that attaches to an ELAN via an ATM interface. When a LES cannot directly resolve an LE_ARP request to proxy LECs, it floods the LE_ARP request to proxy LECs. Proxy LECs do not register non-local (LAN-side) MAC addresses with the LES. For Token Ring emulation, route descriptors (bridge/ring combinations) are registered with the LES.

2.1.3 LAN Emulation Configuration Server (LECS)

The LECS is responsible for the initial configuration of LECs. It provides information about available ELANs that a LEC may join, together with the addresses of the LES and BUS associated with each ELAN.

There is one instance of the LECS per administrative domain that serves all ELANs in that domain.

2.1.4 LAN Emulation Server (LES)

The LES implements the control coordination function for the ELAN. The LES provides the service of registering and resolving MAC addresses or route descriptors (Token Ring emulation) to ATM addresses. A LEC registers its own address with the LES. A LEC also will query the LES when the member wishes to resolve a MAC address to an ATM address. The LES will respond either directly to the client or forward the query to other members so they may respond.

In *ForeThought* 5.0, the LES is co-located with the BUS. Multiple LES-BUS pairs can be implemented in the ELAN to provide redundancy and load sharing. Refer to "Distributed LAN Emulation" on page 2-18.

2.1.5 Broadcast and Unknown Server (BUS)

Unlike traditional shared-media LAN architectures such as Ethernet, ATM is connection based. Therefore, it has no built-in mechanism for handling connectionless traffic such as broadcasts, multicasts, and unknown unicasts. In an emulated LAN, the BUS is responsible for servicing these traffic types by accepting broadcast, multicast, and unknown unicast packets from LECs and proxy LECs to the broadcast MAC address (FFFFFFFFFFFF) via dedicated point-to-point connections, and forwarding the packets to all of the members of the ELAN using a single point-to-multipoint connection. Each LEC is associated with only one active BUS per ELAN. *ForeThought 5.0.x* also supports the use of "intelligent" BUSs that allow the BUS to use the LES's registration table to direct unicast traffic.

In *ForeThought* 5.0, the BUS is co-located with the LES. Multiple LES-BUS pairs can be implemented in the ELAN to provide redundancy and load sharing. Refer to "Distributed LAN Emulation" on page 2-18.

2.2 Emulated LAN Operation

This section describes the operation of an ELAN and its components from the point of view of a LEC. The operation of an ELAN may be divided into three phases:

1. Initialization
2. Registration and Address Resolution
3. Data Transfer

ELAN components communicate with each other using ATM connections. LECs maintain separate connections for traffic control functions and data transfer. The following connection types are used by the LEC when operating in an ELAN:

- *Configuration-Direct Connection*: a bidirectional point-to-point VCC set up by the LEC to the LECS.
- *Control-Direct Connection:* a bidirectional point-to-point VCC set up by the LEC to the LES. This connection must be maintained for the duration of the LEC's participation in the ELAN.
- *Control-Distribute Connection*: a unidirectional point-to-multipoint VCC set up by the LES to the LEC. This connection must be maintained for the duration of the LEC's participation in the ELAN.
- *Multicast-Send Connection*: a bidirectional point-to-point VCC set up by the LEC to the BUS for sending multicast data to the BUS. The LEC must attempt to maintain this connection while participating in the ELAN.
- *Multicast-Forward Connection*: a unidirectional point-to-multipoint VCC set up from the BUS to LECs participating in the ELAN. This VCC must be established before a LEC participates in an ELAN. The LEC must attempt to maintain this connection while participating in the ELAN.
- *Data-Direct Connection*: a bidirectional point-to-point VCC set up between LECs that want to exchange unicast data traffic.

For the following discussion, please refer to Figure 2.2.

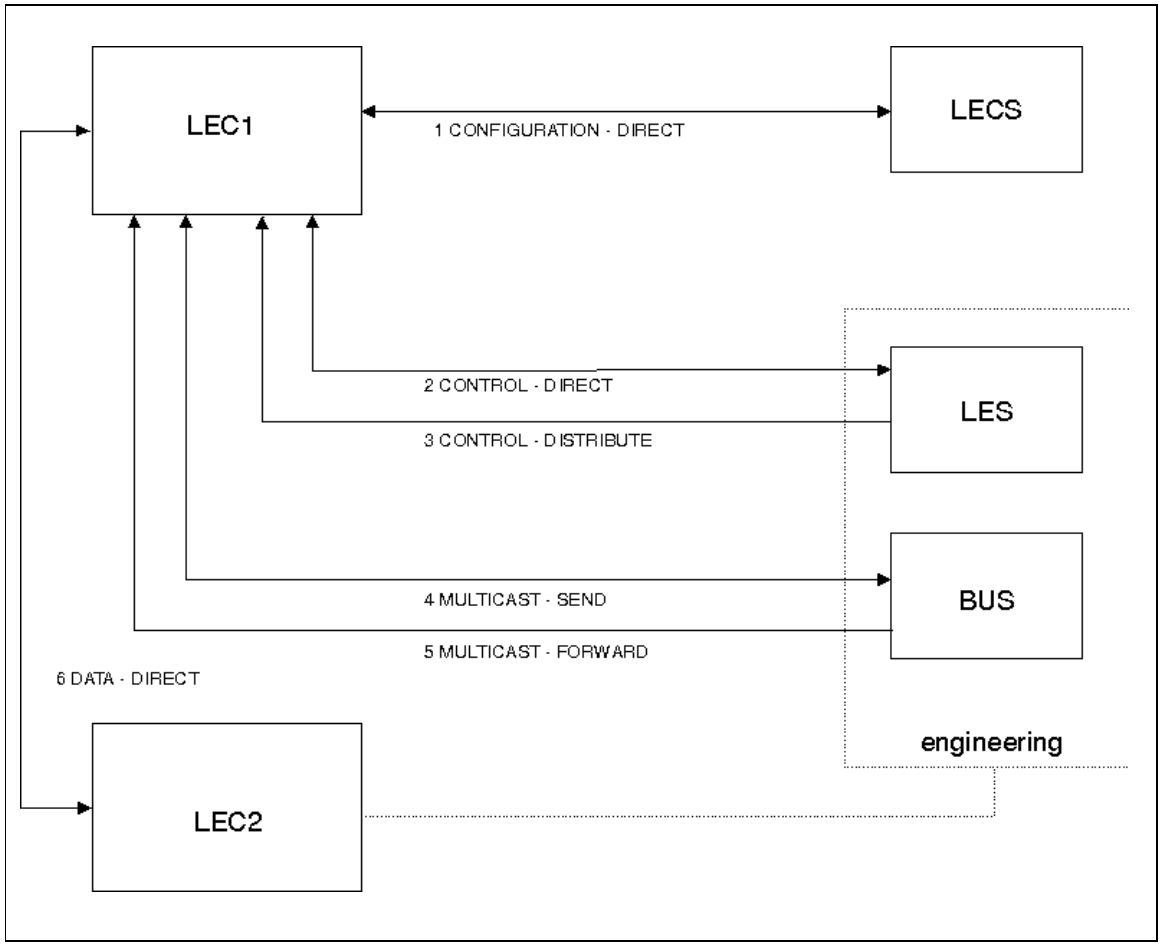


Figure 2.2 - ELAN Operation

2.2.1 Initialization

Upon initialization, LEC1 obtains its own ATM address via address registration. LEC1 obtains the location of the LECS in one of three ways: via manual configuration, via the "well-known" address, or via PVC (0,17).

Once it finds the location of the LECS, LEC1 establishes a configuration-direct connection ❶ to the LECS. When connected, the LECS provides LEC1 with the information necessary to connect to the ELAN it wishes to join. This information includes such parameters as the ATM address of the ELAN's LES, the type of LAN being emulated, maximum packet size, and the name of the ELAN (engineering, for example). This configuration information is contained in a text file that must be configured by the network administrator.

Detailed information about the LECS configuration file may be found in the *ForeRunner* ATM Switch Configuration Manual.

2.2.2 Registration and Address Resolution

After obtaining the address of the LES, LEC1 establishes a control-direct connection ❷ to the LES. The LES then assigns LEC1 a unique identifier, and LEC1 then registers its own MAC and ATM addresses with the LES (The LES maintains a table containing the MAC addresses and corresponding ATM addresses of all members of the ELAN). At this point, LEC1 has "joined" the ELAN.

The LES then establishes a control-distribute connection ❸ back to LEC1. Connections ❷ and ❸ can now be used by LEC1 to send LAN Emulation ARP (LE_ARP) requests to the LES, and receive replies.

LEC1 now LE_ARPs to the LES to get the ATM address of the BUS corresponding to the broadcast MAC address (FFFFFFFFFFFF). The LEC then establishes a multicast-send connection ❹ to the BUS. The BUS responds by setting up a multicast-forward connection ❺ to the LEC.

At this point, the LEC is ready to transfer data.

2.2.3 Data Transfer

When LEC1 receives a network-layer packet from a higher layer protocol to transmit to some destination MAC address (for example, LEC2), LEC1 initially does not know the ATM address of the destination, LEC2, corresponding to the destination MAC address. Consequently, LEC1 transmits an LE_ARP to the LES.

The example shown in Figure 2.2 assumes that LEC2 has already registered with the LES, and that connections similar to those described for LEC1 already exist.

While waiting for the LES to respond, LEC1 forwards the packet to the BUS. The BUS broadcasts the packet to all LECs on the ELAN. This is done to avoid data loss and to circumvent connection setup latency (due to the LE_ARP process) that may not be acceptable to some network protocols.

If the LE_ARP response is received, LEC1 establishes a data-direct connection ❻ to the destination address of LEC2. It is this path that will be used for subsequent data transfers. Before LEC1 begins to use this connection, it first sends a "flush" packet via the BUS to the destination, LEC2. When LEC2 acknowledges receipt of this packet, signifying that the BUS path is empty, only then will LEC1 begin to use the data-direct connection ❻ for data transfer. This process ensures that the network protocol's frames arrive in the proper order.

If no response is received to the LE_ARP, LEC1 will continue to send data via the BUS, while continuing to LE_ARP until a response is received and a data-direct connection to LEC2 established.

If LEC1 already has a data-direct connection to a MAC address it wishes to reach, it need not go through the LE_ARP process again. Instead, it will continue to use the current connection. This is possible because each LEC maintains a cache of MAC address to ATM address mappings that it receives in response to the LE_ARPs it has sent. Entries in this cache are "aged" out over a period of time. Data-direct connections are also cleared if they remain inactive for a period of time.

2.3 MPOA Overview

MPOA adds functionality to LAN Emulation (LANE) to avoid the significant transmission delays imposed by routers in a LANE network. It does this by performing flow analysis on routed traffic and, when appropriate, creating a direct ATM connection (called a shortcut) for the traffic, eliminating the routed connection. For non-routed traffic within the ELAN, connections are established as they are in a non-MPOA LANE environment.

An MPOA network includes all the components of a LANE network, with the addition of:

- LAN Emulation/Multi-Protocol Clients (LEC/MPCs) running on each endstation.
- a Multi-Protocol Server (MPS) running on a *PowerHub* in the network. (Note that the *PowerHub* is not supported in this version of VLAN Manager.)

The MPCs communicate with the MPS to replace routed paths in the network with shortcuts, avoiding routers.

2.3.1 LANE Without MPOA

ATM networks co-exist with and support network applications which may not be ATM-aware. Consequently, ATM protocols are needed to monitor network protocol (IP, IPX, Appletalk, etc.) packets and perform translation into ATM cells and circuits. This monitoring and translation can be performed in one of the following ways:

- in a host protocol stack *after* packet construction and *before* packet transmission
- in a LAN-to-ATM edge device *as* packets move through the network

LANE is the standard protocol for performing this translation. It resolves datalink layer addresses into ATM addresses and establishes circuits to the destination addresses. Network addresses *within* a subnet can be learned by distributing network address queries using LANE's broadcast support, the BUS.

However, LANE relies on routers to deliver packets *across* subnets (see Figure 2.3). At *every* router, the router must perform the following tasks on the traffic:

1. Reassembles packets from ATM cells
2. Modifies the packets with routing information
3. Re-segments the packets for transmission to the next hop.

This process imposes significant transmission delays between the source and destination of the network traffic.

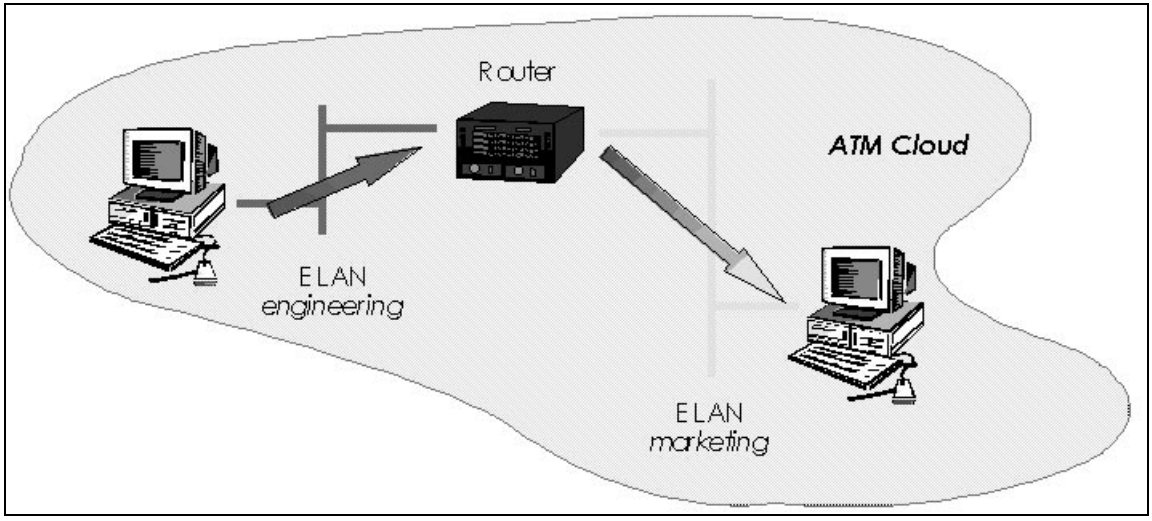


Figure 2.3 - LANE Without MPOA

2.3.2 Next Hop Resolution Protocol (NHRP)

LANE controls communication among clients in the *same* broadcast domain. Different protocols are used *between* domains. (A broadcast domain corresponds roughly to a network subnet or ELAN). In particular, IP routers in ATM networks can communicate with each other using the IETF Internetworking Over NBMA Networks (ION) Working Group's *Next Hop Resolution Protocol* (NHRP). NHRP allows the ATM network to be divided into Logical IP Subnets (LISs). Using NHRP, routers are still required to interconnect these subnets; but NHRP permits intermediate routers to be bypassed on the *data* path. NHRP allows entities called Next Hop Clients (NHCs) to send queries between different subnets. These queries are propagated using Next Hop Servers (NHSs) via paths found using standard routing protocols. Consequently, NHRP enables the establishment of VCC data paths across subnet boundaries *without requiring physical routers in the data path.*

2.3.3 MPOA Integrates LANE and NHRP

The ATM Forum developed the Multi-Protocol over ATM (MPOA) specification to integrate the intra-ELAN communications that LANE supports, with the cross-subnet communications that routers and NHRP support. By integrating these two protocols, MPOA provides faster, more predictable cross-subnet connections.

MPOA introduces LANE/MPOA Clients (LEC/MPCs) and MPOA Servers (MPSs) and defines the protocols that are required for LEC/MPCs and MPSs to communicate. LEC/MPCs issue queries for ATM addresses, and receive replies from the MPS using these protocols. MPOA also maintains interoperability with the existing infrastructure of routers. MPOA Servers reside in routers that run standard Internetwork Layer routing protocols such as OSPF, thus providing integration with existing networks.

2.3.3.1 MPOA Shortcuts

ForeThought 5.0 implements MPOA shortcuts for IP traffic, shown in Figure 2.4. (Other protocols, such as IPX, are supported by the MPOA clients and servers, but traffic using these protocols continues to use the traditional routed path.) It does this by *adding* capabilities to LANE, *not* by replacing LANE. LANE/MPOA client drivers are extended LANE drivers. When handling traffic within the *same* ELAN and subnet, they function like LECs. However, when handling traffic that *crosses* subnets, LEC/MPCs initially work with MPOA servers (MPSs) to use MPS-established hop-by-hop circuits. Then, for traffic flows that exceed configurable limits, shortcut circuits are built to and from the destination that allow the traffic to bypass the normal path through the router, and avoid the router's processing delays.

Consequently, traffic flowing through an MPOA shortcut moves at essentially wire speed from source to destination (see Figure 2.4). Furthermore, because the *shortcut* circuits are re-directing their traffic from the routed path, other traffic that still uses the routers experience less congestion and delay.

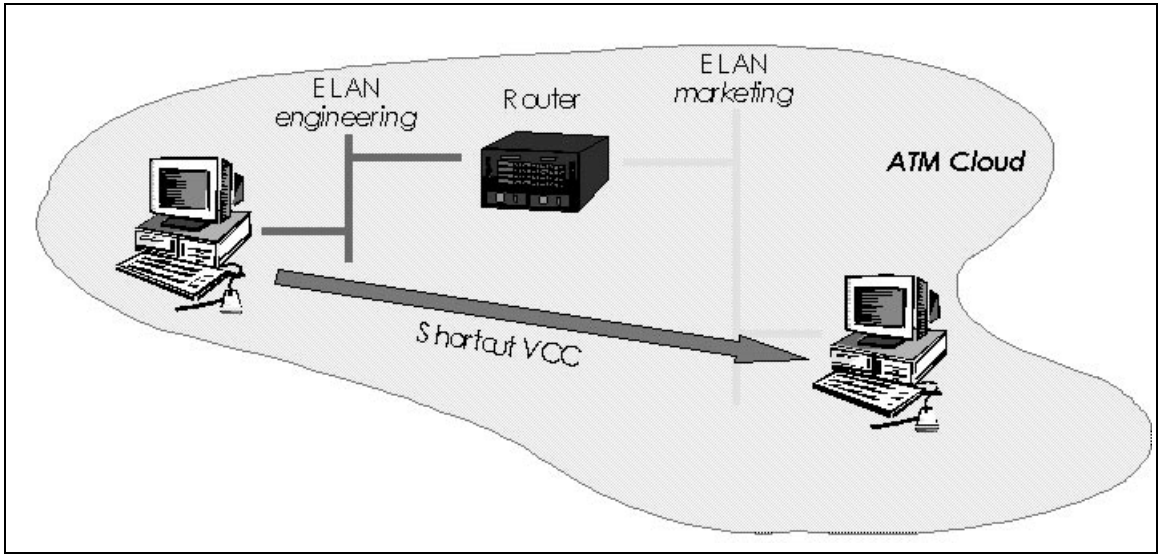


Figure 2.4 - LANE With MPOA

2.3.4 MPOA Components

MPOA requires LANE services for both ELAN traffic handling and MPOA configuration. In addition to the LANE components of LECS, LES, and BUS, an MPOA network includes an extended LEC, referred to as a LEC/MPC, and a Multi-Protocol Server (MPS).

2.3.4.1 LANE/MPOA Client (LEC/MPC)

The LEC/MPC has two functions, depending on the traffic it is handling:

For traffic within the ELAN — The LEC/MPC acts as a LEC and simply communicates with other ELAN components (the LES and BUS) to resolve MAC addresses into ATM addresses.

For traffic outside the ELAN (i.e. routed traffic) — The LEC/MPC acts as an MPC, communicating with the MPS to be a source of and destination of MPOA shortcuts. A LEC/MPC that is the source of a shortcut is known as an *ingress* LEC/MPC. A LEC/MPC that is the destination of a shortcut is known as an *egress* LEC/MPC. The LEC/MPC includes an NHRP Client (NHC).

An ingress LEC/MPC monitors traffic flow that is being forwarded over an ELAN to a router that contains an MPS. When the ingress LEC/MPC recognizes a flow rate that could benefit from a shortcut (and thus bypass the routed path), it asks the MPS for the ATM address of the destination. If the MPS provides the destination ATM address, the ingress LEC/MPC sets up a shortcut VCC, and forwards traffic for the destination over the shortcut. You can configure the flow rates which trigger the shortcut creation.

An egress LEC/MPC receives internetwork traffic from other LEC/MPCs to be forwarded to its local interfaces/users. For traffic received over a shortcut, the egress LEC/MPC encapsulates the packets as if they had been received via the routed path, and forwards them via a LAN interface (that may be a bridge or switch port, an internal host stack, etc.).

2.3.4.2 MPOA Server (MPS)

An MPS includes an NHRP Server (NHS) and is the logical component of a router that provides internetwork layer forwarding information to LEC/MPCs. The MPS answers MPOA queries from ingress LEC/MPCs and provides encapsulation information to egress LEC/MPCs.

The MPS runs on a *PowerHub*. Note that management of *PowerHub*s (and MPSs) is not supported in this release of VLAN Manager.

2.3.5 MPOA Example

The following are the basic requirements for establishing a shortcut across an MPOA-enabled network:

- the traffic flow must consist of IP traffic.
- there must be LEC/MPCs at each end of the network between which a shortcut is desired.
- the local router interface at each end must be running an MPS.
- a Next Hop Resolution Protocol (NHRP) path must exist between MPSs.

The following example illustrates a typical ATM network that allows MPOA shortcuts to be employed.

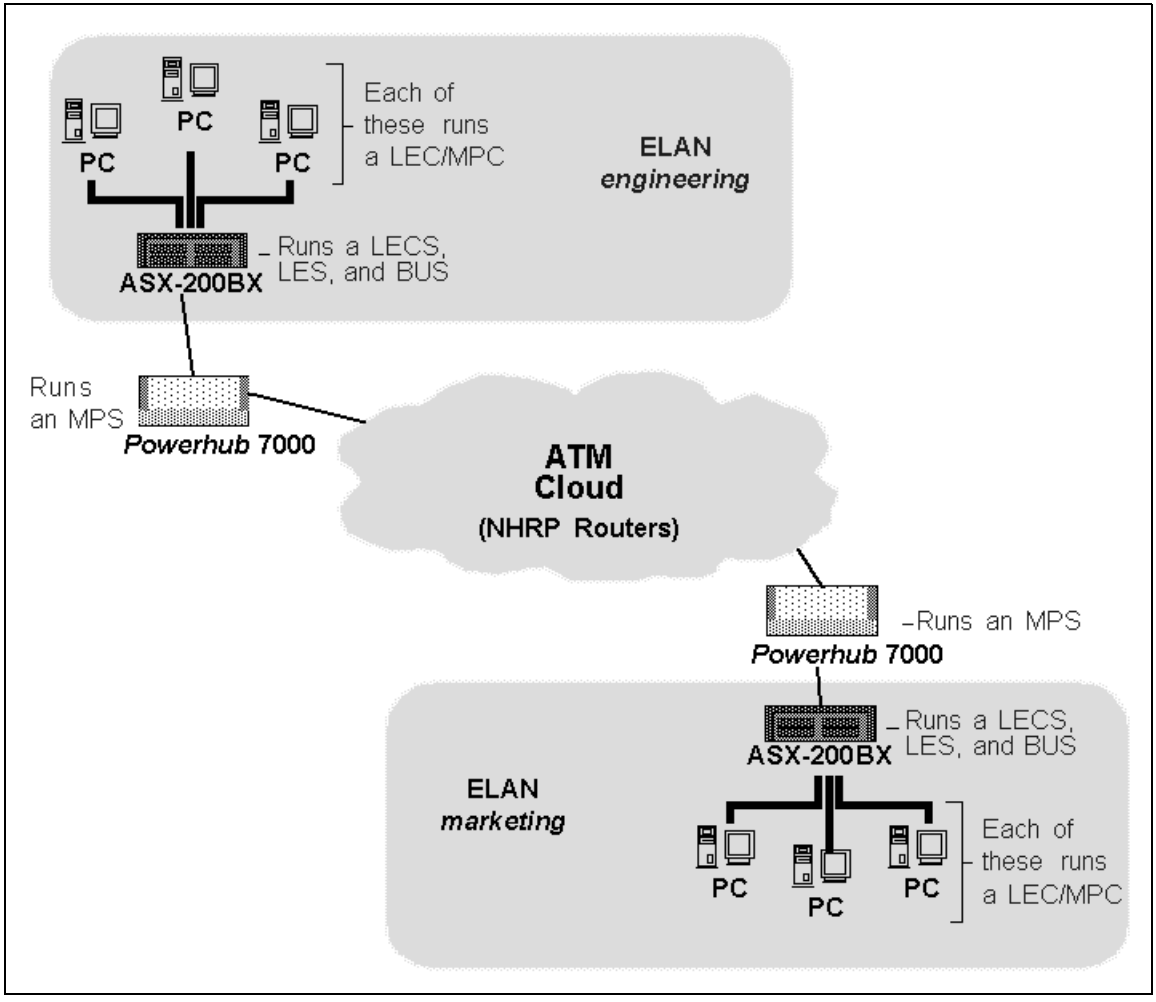


Figure 2.5 - MPOA Example Network

2.3.5.1 MPS Configuration

As with any other router, the network administrator must configure each MPS with the site-specific IP address matching the gateway address being used by LEC / MPCs in its ELAN.

The MPS on each *PowerHub* 7000 or 8000, or ASN-9000 is configured as follows:

1. For each LANE / MPOA virtual port, specify an ELAN name. The LECS configuration must also be updated to allow the MPS to join these ELANs.
2. For each LANE / MPOA virtual port, specify an IP address.
3. Enable LANE / MPOA support.
4. Enable routing.
5. Save the configuration and reboot the MPS if necessary to make the changes effective

Router table information need not be configured. The MPS will instead gather this information through routing protocol exchanges with other MPSs.

Configuration of *PowerHub* edge devices is not supported in this release of VLAN Manager.

2.3.5.2 LEC/MPC Initialization

When its host boots, *each* LEC / MPC automatically goes through the following sequence to establish a connection to the MPS.

1. The host registers via ILMI with the switch to which it is attached in order to learn its ATM address.
2. The LEC / MPC connects to an LECS to which it sends its own ATM address and the name of the ELAN it wishes to join (the ELAN name is an empty string unless the LEC / MPC has been site-configured with an ELAN name). The LEC / MPC also supplies a LANE 1.0 compliant parameter identifying itself as an MPOA-aware client.
3. Next, the LEC / MPC receives the following from the LECS:
   - the name of the ELAN to which it is assigned.
   - the ATM address of the LES for the ELAN it is joining.
   - if the LECS is MPOA-aware and has been configured with them, the parameters containing the flow detection and shortcut establishment policies it is to use.

4. The LEC/MPC then connects to its assigned LES, and provides the LES with a parameter identifying itself as MPOA-aware.
5. Finally, the LEC/MPC connects to the ELAN's BUS.

Once these connections are established, third-party network-layer protocol drivers on the host can establish network-layer connectivity. The methods these upper-layer drivers use to determine host IP addresses, default gateway, and backup gateway addresses vary depending on the third-party product. For example, the LANE/MPOA driver itself permits these drivers to use BOOTP or DHCP to obtain IP configuration information.

2.3.5.3 Flow Analysis

On a LEC/MPC's host or edge device, IP packets with destinations *within* the host's subnet are sent using LANE 1.0 methods; i.e., the client acts as an LEC and works directly with its ELAN's services to connect with local destinations. Packets destined for *remote* subnets cause the LEC/MPC to act as an MPC. This client is then referred to as an "ingress LEC/MPC".

Ingress LEC/MPCs associate destination IP addresses with shortcut circuits. Ingress LEC/MPCs use configurable parameters called *flow descriptors* to determine *whether* and *when* to trigger creation of shortcut circuits. The ingress LEC/MPC also monitors the most recent use of a shortcut circuit to determine when to tear down the shortcut. Specifically, when an ingress LEC/MPC sends a packet:

1. If a shortcut circuit *already exists* to the IP destination, the LEC/MPC sends the packet over this circuit.
2. If no shortcut circuit exists, the LEC/MPC determines *whether* shortcuts to this IP address are allowed. If shortcuts to the destination IP address are *not* allowed, the LEC/MPC sends the packet to the gateway router.
3. If no shortcut circuits exist, *and* shortcuts to the IP address *are* allowed, the LEC/MPC determines if the packet traffic flow exceeds the shortcut enable trigger value (set by the flow descriptors) for the destination IP address's flow.
    - If the flow exceeds the trigger value, the LEC/MPC tries to establish a shortcut circuit to the destination LEC/MPC (called the egress LEC/MPC).
    - If the flow does not exceed the trigger value, the ingress LEC/MPC simply sends the packet traffic to the gateway router.

2.3.5.4 Making a Shortcut

When the ingress LEC / MPC determines that the packet traffic flow exceeds the shortcut trigger value, the ingress LEC / MPC tries to establish a shortcut circuit to the egress LEC / MPC. The following describes how a shortcut is set-up:

1. The ingress LEC / MPC initiates the shortcut creation process by sending a request, called a next hop resolution protocol (NHRP) request, to the MPS it uses as a gateway router (this MPS is called the *ingress* MPS). This NHRP request includes the destination's IP address and asks for the corresponding ATM destination address.
2. This request is passed along hop-by-hop until it reaches the final MPS (called the *egress* MPS) on the route to the destination IP address.
3. The egress MPS looks up the ATM address corresponding to the destination IP address, and checks if the device at that address has registered with the local LES as MPOA-capable. If so, it returns the destination ATM address in a NHRP response hop-by-hop to the ingress LEC / MPC.
4. When the ingress LEC / MPC receives the NHRP response containing the destination's ATM address, it first checks if a shortcut circuit to that ATM address already exists. If a shortcut circuit to that address already exists, it sends the packets via the existing shortcut circuit. (For example, this would occur if the ingress MPC was trying to set up a shortcut to a second Ethernet IP station attached to a single ES-3810.) If no shortcut circuit exists it opens a new shortcut circuit and begins sending packets over it to the destination.

2.3.5.5 Shortcut Teardown

Application programs and networking protocol stacks are MPOA-ignorant and therefore do not tear down shortcut circuits when the shortcut is no longer needed. Therefore the MPOA layer itself tears down seldom-used shortcuts to avoid circuit exhaustion in the client and network. When a shortcut is idle for a period exceeding a limit (configurable at the domain and ELAN level), the shortcut is torn down.

2.4 Distributed LAN Emulation

Distributed LAN Emulation (DLE) allows the LES and BUS functions that are provided to each ELAN to be distributed among multiple, interconnected server platforms. In this way, DLE provides these ELANs with resiliency and scalability.

To understand DLE operation, it is useful to compare DLE to the current LANE service model, which uses a single LES and BUS for each ELAN. Because the LES-BUS pair is a single entity, several limitations exist:

- No provisions are made for load-sharing. Using this model, the resources of the LES and BUS may be exhausted when servicing hundreds of LECs while other applications on the switch are consuming large amounts of bandwidth.
- Remote LECs that are connected to the single LES-BUS pair through a slow-speed link may experience latency and a lack of bandwidth.
- Limited provisions are made for back-up servers. Currently, multiple redundant services can be configured for an ELAN. However, this method does not provide load sharing capabilities.

2.4.1 Distributed LAN Emulation Model

To address the limitations of the single server model, DLE distributes the LANE services load among a mesh of LES-BUS DLE peer servers. Each DLE peer server actually maintains two sets of connections: one is a point-to-multipoint connection to each of its peers for broadcasting multicast data and flooding control information, and the other includes individual point-to-point connections to each peer for directed control traffic.

Each DLE peer server that supports the ELAN is responsible for registering and giving reports about the LECs that are attached to it directly. Each DLE peer server propagates this information to both its locally attached LECs and its peers.

Each device running a DLE peer server must use *ForeThought* 5.0.x; however, the DLE peer servers support clients and attached switches using *ForeThought* 4.0.x and 4.1.x, and third-party devices that are ATM Forum LANE 1.0 compliant.

2.4.1.1 Advantages of DLE

As mentioned earlier, using DLE provides solutions to the problems of using a single server.

2.4.1.1.1 Load Sharing

DLE peer servers distribute the circuit and processing load. The number of LANE LECs is no longer limited by the number of circuits one LES-BUS platform can maintain, since many platforms can support a single ELAN. Also, more VCs are available for use by other applications.

2.4.1.1.2 Improved Performance for Remote LECs

With DLE, broadcast delivery and LE-ARP resolution across peer servers can take a little longer than if all LECs were connected to a single server, since extra processing steps and transmissions are needed. However, ELANs with groups of LECs in different locations can be designed for higher performance by providing a DLE peer server with each group. Broadcasts and address resolution within each group will improve.

2.4.1.1.3 Fault Tolerance

Perhaps the most important advantage of DLE is fault tolerance. In a single server ELAN, the server can be a single point of failure. If the server fails, endstations in the ELAN are unable to discover each other through broadcast queries and unable to resolve MAC addresses into ATM addresses. Increased network reliability, therefore, requires that ELANs have backups for LES and BUS functions.

2.4.1.2 DLE ELAN

As noted previously, having a single server supporting an ELAN has a potential problem because the server can be a single point of failure. However, DLE can address this problem. By attaching the ELAN LECs to multiple DLE peer servers which communicate with each other as described earlier, the number of LECs affected by a server failure is reduced, and a backup server is provided for affected LECs to use.

2.4.1.3 Upgrading Failover ELANs

VLAN Manager does not support failover ELANs, supported in earlier version of *ForeView*. However, the transition from failover to DLE can be done smoothly using VLAN Manager. Using VLAN Manager, you can:

1. Sync in the failover ELANs.
2. Delete and then recreate them (after upgrading the switches if necessary outside the VLAN Manager) as DLE peers.
3. Restart the clients manually outside the VLAN Manager.

CHAPTER 3 Quick Start Guide to VLAN Manager

This chapter describes how to start using VLAN Manager, either to manage a new domain created by VLAN Manager or to manage VLANs on a domain that had been manually created and managed. This chapter also provides an example of how to configure ELANs on a simple network.

3.1 Installing VLAN Manager

VLAN Manager is installed as a patch to your existing *ForeView* installation. Refer to the release notes, included with this VLAN Manager software for information on installation.

3.2 Before Starting VLAN Manager

3.2.1 IP Connectivity

VLAN Manager requires IP connectivity to hosts running LANE services and edge devices (ES-3810s). When it has IP connectivity, VLAN Manager is capable of configuring and monitoring LANE services for ELANs, configuring 802-Style VLANs (on ES-3810s), and configuring Proxy LECs.

To gain IP connectivity, FORE suggests establishing a default ELAN, as described in "Manually Creating a Default ELAN" on page 3-6.

3.2.2 SNMP Read/Write Access

Along with IP connectivity, VLAN Manager requires SNMP read and write access to these hosts and devices. Make sure that the proper community strings are set to allow VLAN Manager read / write access.

3.2.3 Setting System Names

To ensure that icons for VLAN members appear with appropriate labels in VLAN Manager, you should set the `sysname` variables on host devices to an name that resolves to an IP reachable host name.

In the examples in this chapter, devices are given names corresponding to their IP address.

3.2.4 Specifying Management VLANs

A *management VLAN* is one that provides IP connectivity for the management workstation running VLAN Manager. By specifying one or more management VLANs, VLAN Manager subsequently prompts you when you attempt to commit a change that would bring down a management VLAN. This prevents the management workstation from losing IP connectivity.

In the *ForeView* configuration file you can specify one or more VLANs as management VLANs, using the `fvlanMgmtVLANsELANs` resource. If no VLANs are specified in the `fvlanMgmtVLANsELANs` resource, VLAN Manager will prompt you to specify one or more when you start VLAN Manager.

3.3 Starting VLAN Manager

3.3.1 On UNIX Platforms

After installing FOREVIEW on your machine, set your path to include the following:

```
/usr/fore/foreview/bin
```

Also, if you installed FOREVIEW in a directory other than the default (`/usr/fore/foreview`), make sure that environment variable `FOREVIEW_HOME` is set to the directory containing ForeView. Otherwise, `FOREVIEW_HOME` points to the default.

To start the VLAN Manager, type the following command stream at the shell prompt:

```
fvlan
```

3.3.2 On Windows NT

To start the VLAN Manager on a Windows NT system:

1. Press the **Start** button on the task bar.
2. Select **Programs** -> **FORE** -> **ForeView VLAN Manager**.

3.3.3 Management VLANs Prompt

When you start VLAN Manager you will be prompted for a list of any management VLANs you want to protect, as shown in Figure 3.1. When you use the Commit function, any management VLANs you specify in this prompt will not be modified without VLAN Manager first warning you.

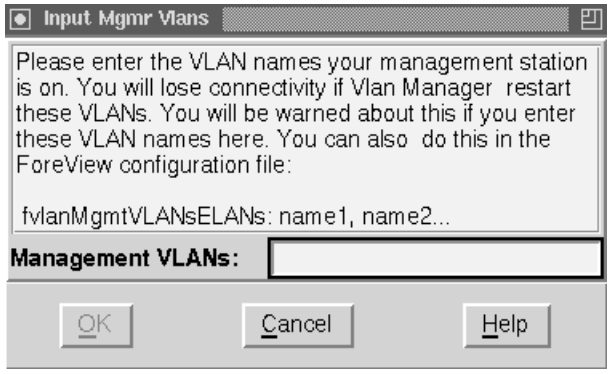


Figure 3.1 - Management VLANs Prompt

You can also specify a list of management VLANs in the *ForeView* configuration file, as described in Section 1.3. In this case the prompt will not appear.

3.4 The VLAN Manager Main Window

After you start the VLAN Manager, the main window appears, as shown in Figure 3.2. The main window is divided into three sections. These sections reflect the network hierarchy:

- The top section identifies the managed domains (`MPOA_WORLD` in Figure 3.2).
- The center section identifies the managed VLANs and their members (`default` is the only VLAN in the domain shown in Figure 3.2).
- The bottom section identifies the managed machines (named for their IP address in the example in Figure 3.2: `4.4.4.2`, `4.4.4.5`, `4.4.4.3`, and `4.4.4.4`).

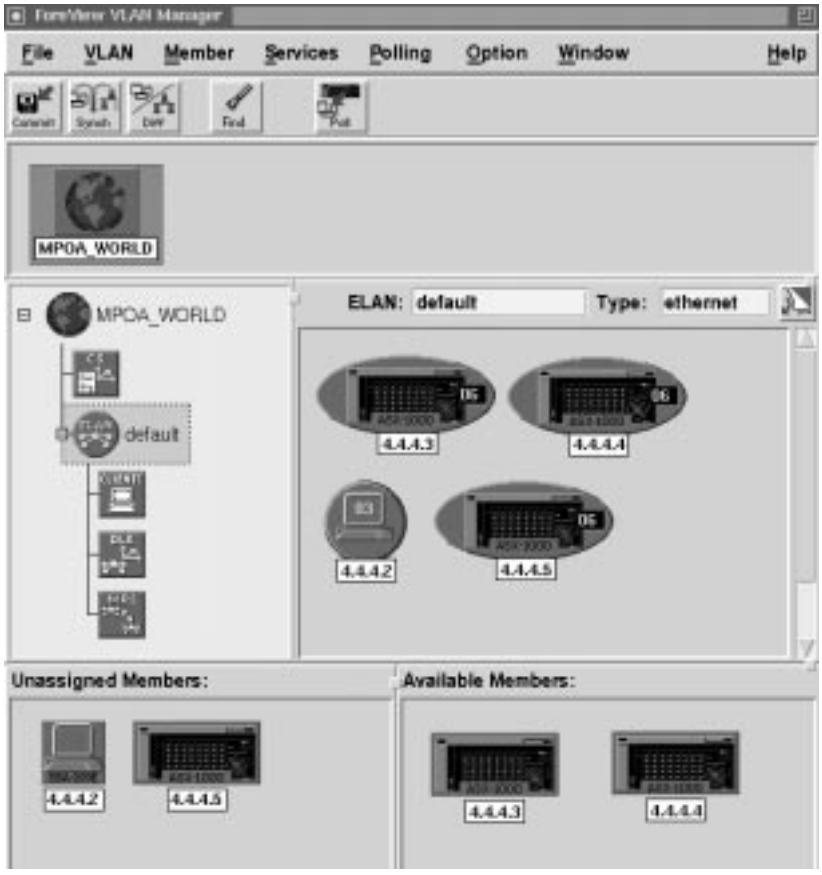


Figure 3.2 - VLAN Manager Main Window

3.5 Creating a New Domain

If you are using VLAN Manager to manage VLANs on a new domain, that does not yet have any configured VLANs or ELANs, and for which no configuration file exists, you can first establish IP connectivity and then proceed to configure VLANs and ELANs using the VLAN Manager GUI.

The easiest way to start using VLAN Manager to manage your VLANs is to have connectivity to all hosts and devices through a `default` ELAN. FORE switches and adapters are configured out-of-the-box to support a default ELAN named `default` with minimal configuration. Given IP connectivity to the hosts and devices running LANE services for `default`, VLAN Manager can discover all the LECs connected to the ELAN. Once VLAN Manager discovers these hosts and devices, you can then use VLAN Manager to configure and monitor VLANs on these devices.

Use the following procedure to establish the default ELAN on a FORE switch.

3.5.1 Manually Creating a Default ELAN

3.5.1.1 Step 1: Start a LES/BUS Pair for DEFAULT

Start a LES-BUS pair for ELAN `default` on a host or switch capable of running LANE services.

Use the same selector byte for LES and BUS pairs.

The following are the AMI commands for starting a LES/BUS pair:

```
localhost::> conf lane les
localhost::configuration lane les> new 0x05 0x05 default
localhost::configuration lane les> show
Index AdminStatus OperStatus LesSel Type       MTU   ELAN     SECURE  TLVs
2     up          up         0x05   ethernet   1516  default  disable enable
   LES : 0x47.0005.80.ffe100.0000.f21a.3675.0020481a3675.05

   BUS : 0x47.0005.80.ffe100.0000.f21a.3675.0020481a3675.05 (Co-Located)
```

3.5.1.2 Step 2: Start the LECS

Start an LECS by providing the ATM address of the LES for the 'default' ELAN. If you are using DLE to run multiple LES-BUS pairs, provide the anycast address. The following are the AMI commands for starting the LECS on an ASX switch:

```
localhost::> conf lane lecs
localhost::configuration lane lecs> new 0x06 -default
0x47.0005.80.ffe100.0000.f21a.3675.0020481a3675.05
localhost::configuration lane lecs> show
Index  AdminStatus  OperStatus   Selector  WKA         Database
   1  up           up              0x06  atm-forum   lecs.cfg

    Default LES :0x47.0005.80.ffe100.0000.f21a.3675.0020481a3675.05
```

3.5.1.3 Step 3: Configure a LEC on Each Host and Switch

Now configure a LEC to join default ELAN on each of the hosts and switches on which you plan to run LANE services. Also configure the virtual interface created by the LEC with an IP address.

The other hosts and devices in the network will automatically attempt to connect to `default`, because they are pre-configured to do so. However, you must assign IP addresses to these devices for the default ELAN.

The following are the AMI commands for starting the LEC and assigning an IP address on an ASX switch:

```
localhost::> conf lane lec
localhost::configuration lane lec> new 0x0a default
localhost::configuration lane lec> show

        Admin   Oper
Index  Status  Status   Sel   Mode       MACaddress    IfName    ELAN
    1  up      down     0x0a  wellknown  0020481a3675  el10      default

         LECS:0x47.0079.00.000000.0000.0000.0000.00a03e000001.00
         LES :00000000000000000000000000000000000000000000

localhost::configuration lane lec> conf ip

localhost::configuration ip> address el10 192.168.68.32
localhost::configuration ip> admin el10 up
```

3.5.1.4 Step 4: Verify Connectivity

Verify that the LECs have joined the `default` ELAN. If the LES/BUS pair is running on a *ForeRunner* ATM switch, you can invoke **`conf lane les show advanced`** command to view a list of all LECs connected to the switch.

Attempt to ping between the devices in the network.

3.5.2 The Next Step

After IP connectivity is established, you can proceed to use the VLAN Manager to configure VLANs on the network. Refer to "Configuring a Simple Network" on page 3-9 for an example of how to use VLAN Manager to configure VLANs on a simple network.

3.6 Managing a Previously Configured Domain

If you are using VLAN Manager to manage a domain that was previously configured manually, without VLAN Manager, you will need to take steps to ensure that VLAN Manager gets all the information it needs about the devices and VLANs in the domain. Create a new domain, and then use the Sync function to make VLAN Manager aware of information about the previously configured network.

3.6.1 Using the Sync Function

This procedure describes how to use the Sync function with a network that was previously configured manually:

1. Create one or more administrative domains by using the **`Create Admin Domain...`** option under the File menu.
2. Under each administrative domain, create member icons for machines that are running LANE services by using the **`Create Member...`** option under the Member menu. If you have 802-style VLANs on ES-3810s that you also want to manage through the VLAN Manager, you will need to create member icons for the ES-3810s also.
3. Now, press the **Sync** button on the toolbar. The VLAN Manager will bring in appropriate information from all the members regarding the services and clients.

4. All LANE parameters (except LAN Type, Maximum Frame Size, and Forward Registration TLVs) will be overridden by defaults when you perform the Sync function. To re-establish the LANE parameters overrides that you had manually configured prior to using VLAN Manager, you must edit the LANE parameters within VLAN Manager:
   a. Select the ELAN icon in VLAN Manager.
   b. Select the **Modify** option under the VLAN menu. The Modify VLAN dialog appears.
   c. Select the **Properties...** button. This displays the Properties Management window, through which you can edit the LANE parameters for the ELAN.
5. Press the **Commit** button on the toolbar and review the Task list, or use the Diff function to ensure that the information is, in fact, correct. You can also modify the configuration before you perform the Commit function. Once you Commit, the VLAN Manager will write out all the information to the configuration file, enabling you to manage the network through the VLAN Manager.

3.7 Configuring a Simple Network

This section shows the steps, with examples, for configuring VLANs on a simple MPOA network. Review this section and then refer to the following chapters for detailed descriptions of the VLAN Manager interface, functions, and configuration commands.

When configuring a network for the first time, before using VLAN Manager you must provide IP connectivity between all devices. FORE recommends providing IP connectivity via a default ELAN, as described in Section 3.5.1.

After providing IP connectivity, you can proceed to:

1. Start VLAN Manager.
2. Create an administrative domain that will encompass the devices you want to manage.
3. Use the VLAN Manager Sync function to synchronize the VLAN Manager view of the network (which is currently blank) with the actual devices and VLANs.
4. Poll the network to determine the current status of all devices and VLANs.
5. Configure the VLANs as desired.
6. Commit the changes. Until you perform a Commit operation, all changes are maintained within the VLAN Managers internal data structure.

3.7.1 Example

Figure 3.3 shows a simple network in which all components are members of the default ELAN on subnet 4.4.4.x. The ELAN was manually configured, as described in Section 3.5.1. The network consists of:

- An ASX-1000 running the LANE services for default (LES, BUS, and LECS)
- A second ASX-1000
- A Solaris and a Windows NT host

This example illustrates that all devices that are to be managed by VLAN Manager must have IP connectivity. A simple way to provide IP connectivity is by using the default ELAN, as described in "Manually Creating a Default ELAN" on page 3-6. However, you can provide connectivity in any manner that is appropriate for your site.

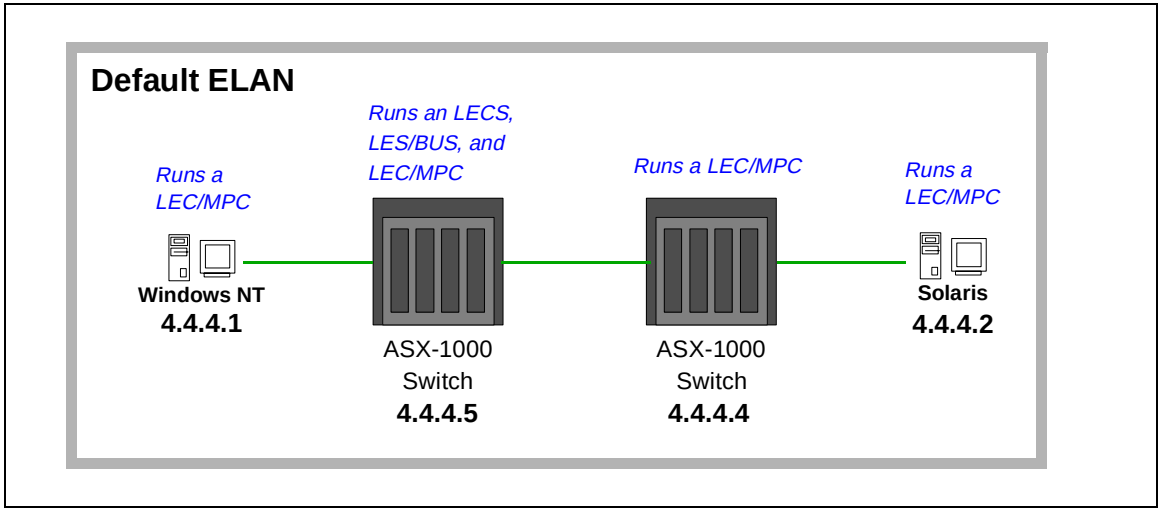


Figure 3.3 - A Simple Network with the Default ELAN

3.7.2 Step 1: Start the VLAN Manager

After installing *ForeView* on your machine, set your path to include the following:

```
/usr/fore/foreview/bin
```

Also, if you installed *ForeView* in a directory other than the default (`/usr/fore/foreview`), make sure that environment variable `FOREVIEW_HOME` is set to the directory containing *ForeView*. Otherwise, `FOREVIEW_HOME` points to the default.

Then, to start the VLAN Manager, type the following command stream at the shell prompt:

```
fvlan
```

3.7.3 Step 2: Create a New Administrative Domain

As a first step, create a new administrative domain. This will create a new LECS configuration file. When you commit your changes in step 5, the LECS will be implemented on the machine you specify as the Configuration Server host.

To create a new administrative domain, select **`File -> Create Admin Domain...`** from the main menu to launch the dialog box, as shown in Figure 3.4.

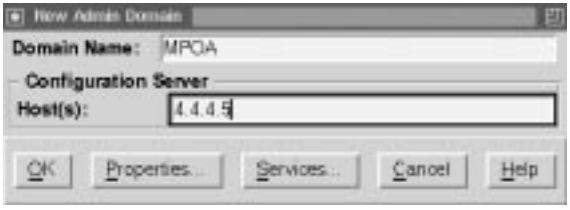


Figure 3.4 - Administrative Domain Dialog

In this example the administrator has specified the domain name, `MPOA`, and the host, `4.4.4.5` on which the LECS is running.

After you press the **OK** button in the New Admin Domain dialog box, VLAN Manager will add the domain to its view. The domain (i.e. LECS file) isn't created until you perform a Commit function. When you do perform the Commit, the VLAN Manager does the following:

- Creates a new `LECS.CFG` file for the domain on the machines specified as configuration servers.
- Stores the configuration file on the specified machine.
- Starts a configuration server on each of the specified machines.

If not using VLAN Manager, you would have to create the LECS.CFG file manually, and issue commands on the machine (an ASX-1000 switch, in our example) to start the LECS.

Refer to "Administrative Domains" on page 6-2 for detailed information on using VLAN Manager to create and modify administrative domains.

3.7.3.1 Example

Figure 3.5 shows the main window after you have created the domain. It shows the MPOA domain in the top portion of the window, the CS icon for the LECS for domain in the middle portion of the window, and, in the Unassigned Members section, the icon representing the machine the LECS is running on.

Figure 3.5 - Main Window with Domain Created

3.7.4 Step 3: Synchronize the Network View

Now that you have created the domain, perform the Sync function by pressing the **Sync** button on the toolbar.

The Sync function will get information from the network and compare it with the information currently maintained by VLAN Manager, and then update the VLAN Manager view to reflect that of the actual network. The Sync function does not change the network to reflect the VLAN Manager view. That is done with the Commit function.

The Sync function will discover active clients that weren't explicitly configured. In our example, the members of the ELAN `default` automatically joined `default` because the FORE equipment is pre-configured for an ELAN named `default` and the clients use the automatic ELAN selection feature. The clients will appear in VLAN Manager as icons labeled with the device's `sysname`. These clients were not explicitly configured, and so appear as oval or round icons. Clients that have been configured through VLAN Manager appear as square or rectangular icons.

Refer to "The Sync Function" on page 5-13 for detailed information on using the Sync function.

3.7.4.1 Example

Figure 3.6 shows the main window after you have synchronized the network view. The VLAN Manager now shows the components of the domain organized into the ELAN `default`.

The Sync function will synchronize the VLAN Manager view with the current network view, provided that VLAN Manager has IP connectivity with the network devices in the domain. IP connectivity is provided by the `default` ELAN in this example, but could be provided by any VLAN that is providing connectivity.

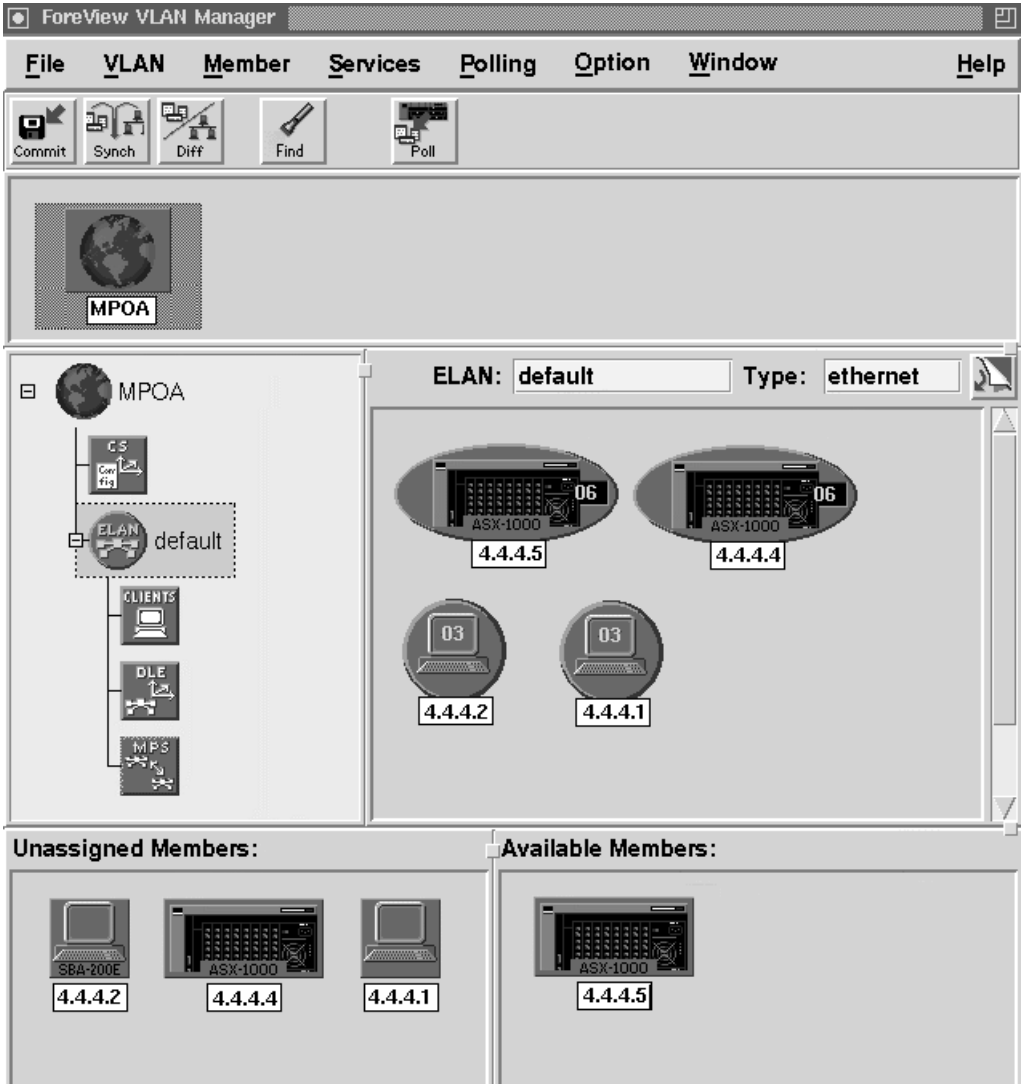


Figure 3.6 - Main Window After Synchronization

3.7.5 Step 4: Configure the VLANs

Now that the VLAN Manager view matches that of the network, you can use the VLAN Manager to manage the network properties and membership of VLANs and ELANs.

If you were not using VLAN Manager, you would have to configure the VLANs by editing the LECS file and issuing commands to start LES-BUS pairs and MPSs on their host machines.

Refer to "VLAN Configuration and Management" on page 6-6 for detailed information on using VLAN Manager to configure VLANs.

Refer to "Performing Drag and Drop Operations" on page 4-3 for detailed information on using the mouse to graphically assign VLAN membership.

3.7.5.1 Example

The current configuration is that shown in Figure 3.3. The user wants to configure two ELANs (while still maintaining connectivity to all devices through the default ELAN), as shown in Figure 3.7. The following procedure shows how to configure these ELANs.

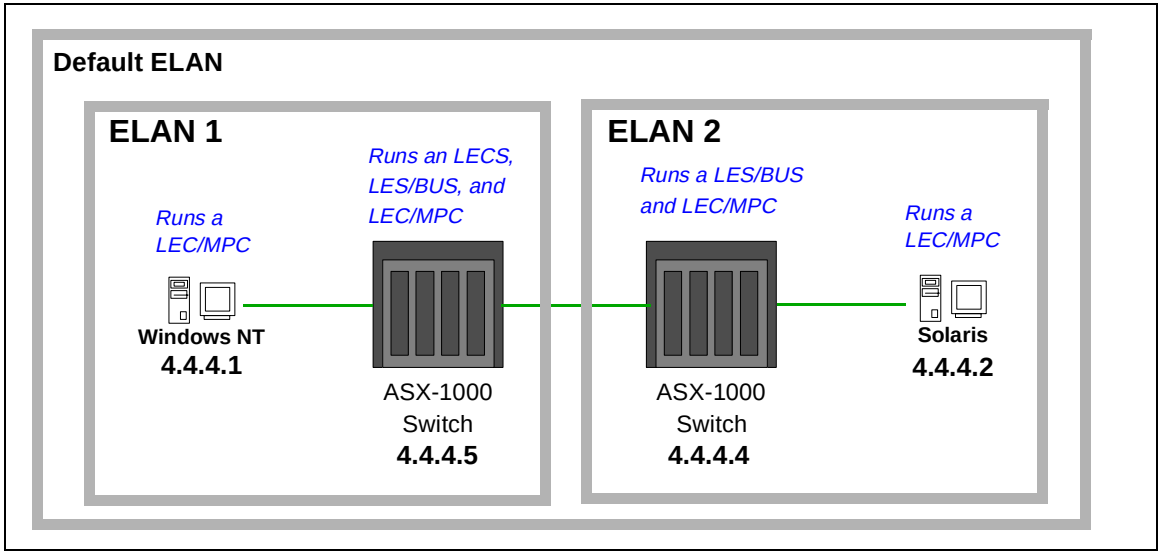


Figure 3.7 - A Simple Network with

The following steps describe how to create ELANs `elan1` and `elan2` as shown in the example:

1. Select the container icon for the domain `MPOA` in the domain area at the top of the main VLAN Manager window.
2. Select **`VLAN -> Create VLAN`**. The Create VLAN dialog box appears, shown in Figure 3.8.
   a. Specify the name as `elan1` with VLAN Type as `ELAN`.
   b. Specify DLE Service(s) as `4.4.4.5`.
   c. Press the **`OK`** button.

   This establishes `elan1` with its LANE services running on ASX1. Icons for `elan1` now appear in the middle portion of the main window.

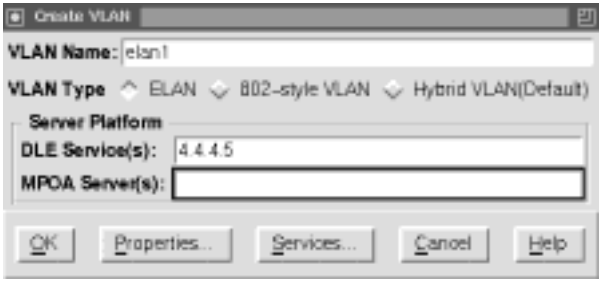


Figure 3.8 - Creating `elan1`

   Press the **`OK`** button to continue.
3. Create ELAN 2 by performing the same actions described in step 2. Specify DLE services `4.4.4.4`, as shown in Figure 3.9.

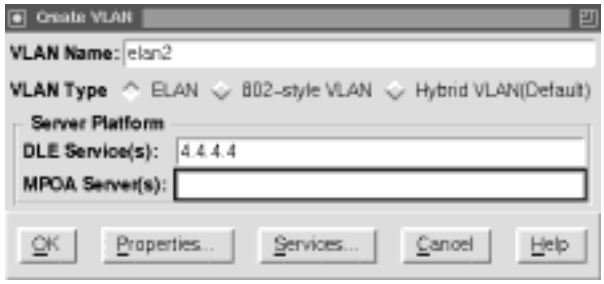


Figure 3.9 - Creating `elan2`

4. Drag and drop the end station members to the ELANs:
   a. Drag the icon for 4.4.4.1 into the icon for `elan1`.
   b. Drag the icon for 4.4.4.2 into the icon for `elan2`.

NOTE You must manually start the LEC drivers on the end hosts.

5. Using the GUI, verify that the ELANs have been created with the correct servers and members.

3.7.6 Step 5: Commit the Configuration

Now that you have added the ELANs for your configuration, you can commit the configuration. This will implement the newly configured domain.

Refer to “The Commit Function” on page 5-3 for detailed information on using the Commit function.

3.7.6.1 Example

1. Press the **Commit** button to commit these changes. The Commit Status window appears.

Figure 3.10 - The Commit Status Window

2. Select the **Proceed** button.

   If VLAN Manager cannot contact one of the devices, a message box appears, indicating that an unreachable host exists. In this example, the Windows NT host is unreachable because it does not run an SNMP agent. Lack of connectivity or SNMP timeouts are among other reasons that a host might be unreachable. Press the **OK** button to proceed.

3. You can press the **Show Diff** button to list the differences between the current VLAN Manager view and the network.

   The Diff message will appear whenever VLAN Manager discovers a difference between the actual network and the GUI's view of the network (not counting the changes made to the network configuration by the user in VLAN Manager).

4. The Commit window lists the tasks it must perform to commit the changes, as shown in Figure 3.11. You can edit the list if necessary by double-clicking on specific tasks in the list. When you de-select a task by double-clicking on it, an X appears next to the task, instead of the checkmark.

Figure 3.11 - Commit Window Showing Tasks

5. Select the **Proceed** button. The Commit function makes the changes, creating the ELANs and starting the services. As the tasks are completed a smiley-face icon appears next to those tasks that have been successfully completed, as shown in Figure 3.12.

Figure 3.12 - Commit Status Window

The VLAN configuration is now complete. It appears in the VLAN Manager GUI as shown in Figure 3.13. To complete the network configuration, you must:

- Configure the end-stations, starting an ELAN interface and assigning the appropriate IP address.

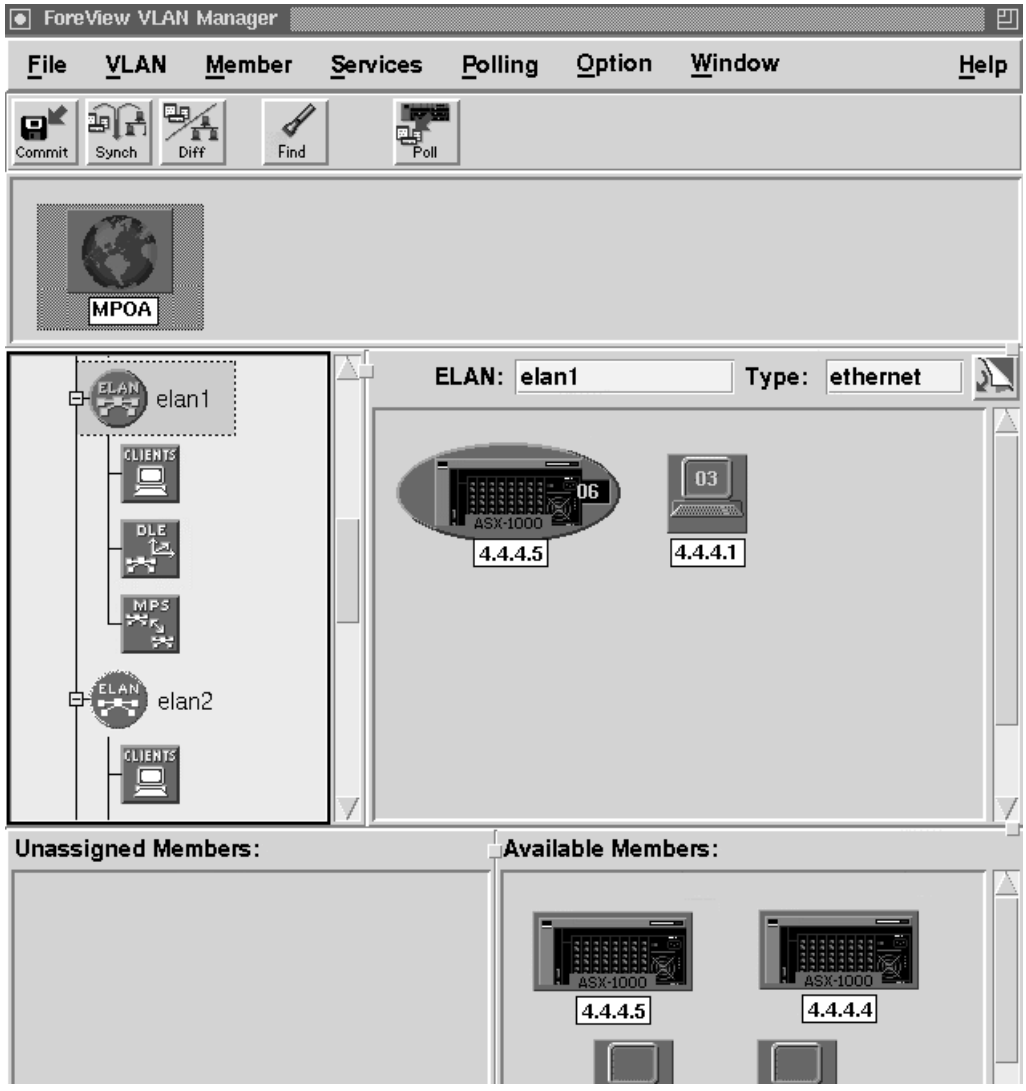


Figure 3.13 - Completed Configuration in VLAN Manager

3.8 For More Information

For more information, refer to the following chapters in this manual, as described in Table 3.1.

Table 3.1 - For More Information

For Information On...	Refer to
Using the VLAN Manager Interface	Chapter 4
Using the Toolbar Functions	Chapter 5
Configuring VLANs and Members	Chapter 6
Modifying VLAN Properties	Chapter 7

CHAPTER 4 Using the VLAN Manager Interface

This chapter describes the layout and usage of the VLAN Manager GUI. Using the GUI, you can create and modify domains, VLANs, and VLAN members. Through simple drag-and-drop operations you can easily change VLAN membership.

Refer to Table 4.1 to find desired information in this chapter.

Table 4.1 - Where to Find Information

For information on...	Refer to...
The Main Window	page 3-2
Managing Domains	page 3-4
Managing VLANS	page 3-7
Managing Members	page 3-15
Using Tear-off Windows	page 3-18
Menu Options	page 3-20

4.1 The VLAN Manager Main Window

As shown in Figure 4.1, the VLAN Manager's main interface window is divided into three sections. These sections reflect the network hierarchy:

- The top section identifies the managed domains (`MPOA_WORLD` in Figure 4.1).
- The center section identifies the managed VLANs and their members (`default` is the only VLAN in the domain shown in Figure 4.1).
- The bottom section identifies the managed machines (named for their IP address in the example in Figure 4.1: `4.4.4.2`, `4.4.4.5`, `4.4.4.3`, and `4.4.4.4`).

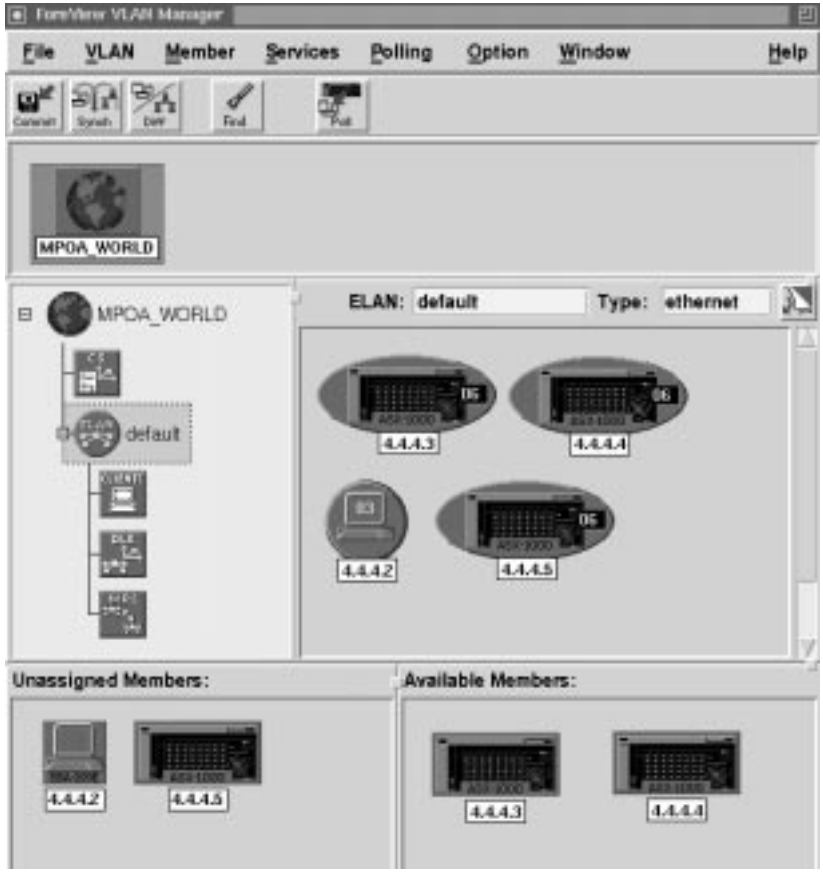


Figure 4.1 - VLAN Manager Main Window

4.1.1 Performing Drag and Drop Operations

Drag-and-drop mouse operations play an important role in the VLAN Manager, and can eliminate the need to use many of the menu commands. You can use the mouse to drag and drop icons on the GUI in order to:

- move a member from one VLAN to another
- assign an unassigned or available device to a VLAN.
- assign machines to run services by dragging the machine into the appropriate icon (CS, MPS, or DLE). By dragging machines into a DLE icon, you add additional peer services, as shown in Figure 4.12.

VLAN Manager will only allow valid operations. For example, it won't allow you to drag a machine that does not support services into a services container icon.

Table 4.2 - Performing Drag and Drop Functions

Action	How To Perform
Select	To select a single entity, click on the icon by pressing the *left* mouse button. The selected icon will be highlighted. To select multiple entities, press the *control* key and click on all the icons you want to select. All the selected icons will be highlighted. The selection need not be in a contiguous area.
Drag	Now move the cursor to the desired location, while *holding* the *left* mouse button down. When you start dragging, the cursor changes to an outline of the selected icon. In case of multi-selection a different cursor icon will be used. When the cursor moves over valid destinations, those icons will be highlighted.
Drop	After reaching the destination, drop the selected items into it by *releasing* the *left mouse button.* When you release the left mouse button, all selected items will be moved to the destination VLAN and the highlight is removed. The cursor is reset to its original shape.

It is important to note that the changes do not take effect until you decide to commit the changes by selecting the **`File -> Commit Changes`** menu option.

4.2 Managing Domains With the GUI

The top portion of the VLAN Manager's user interface lists all the domains currently managed by the VLAN Manager. A domain represents a segregation of VLANs defined by a network administrator. Each domain is administered by a LAN Emulation Configuration Server (LECS) which the network administrator defines during the creation of a domain. More than one LECS can be defined for a domain to provide redundancy.

In a non-ATM/non-LANE environment, there is no need to define or run any configuration servers.

Figure 4.2 - Managed Domains

4.2.1 Domain Status

Each domain is represented by a icon. The color of the icon indicates the status of the domain. The status of the domain is the aggregate of statuses of all the VLANs and Configuration Servers for that domain. The domain status is indicated by the following colors:

Red Down. All VLANs are down, or non-operational.

Yellow Marginal. Some of the VLANs are up and some are down.

Green Up. The VLAN(s) are up.

Blue Unknown. If no configuration servers are defined (non-LANE environment), or the domain has been opened but a poll operation hasn't been performed to determine the state of the network, the icon is colored blue.

Gray Edited. Represents an edited state, in which changes have been made using the GUI but the Commit function has not yet been performed.

NOTE The status colors defined above are used consistently throughout the VLAN Manager to determine ELAN, VLAN, and member status.

4.2.2 Viewing and Adding Configuration Servers for a Domain

You can view the configuration servers for the domain in the center section of the window, shown in Figure 4.3. Click the square icon marked CS, immediately below the Domain icon to view the machines acting as configuration servers in the right hand portion on the window.

You can drag-and-drop machines from the bottom portion of the window to the CS icon to add that machine as a configuration server. Figure 4.4 shows drag-and-drop being used to add a new configuration server on an ASX-1000 switch.

Double-click on the CSs icon to launch the Properties dialog through which you can modify the selector bytes for the configuration services. The selector byte for the configuration server is shown in the icon for the server.

In Figure 4.3, an ASX-1000 is acting as the configuration server for the `MPOA` domain. The LECS is using selector byte `06`. Possible machines that can act as configuration servers include ASX switches, and Sun Solaris workstations.

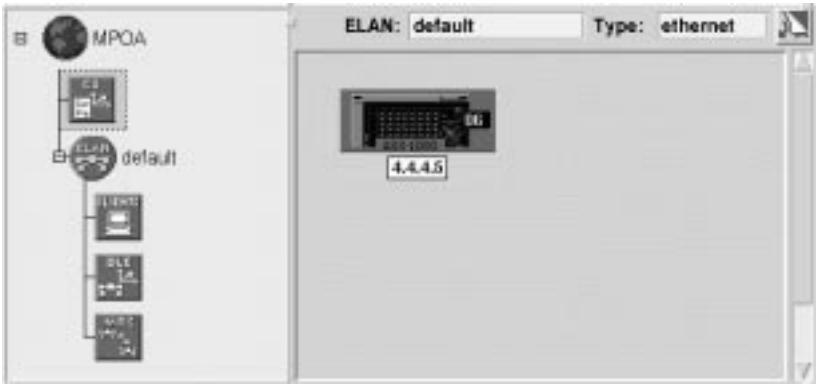


Figure 4.3 - Configuration Servers for the MPOA Domain

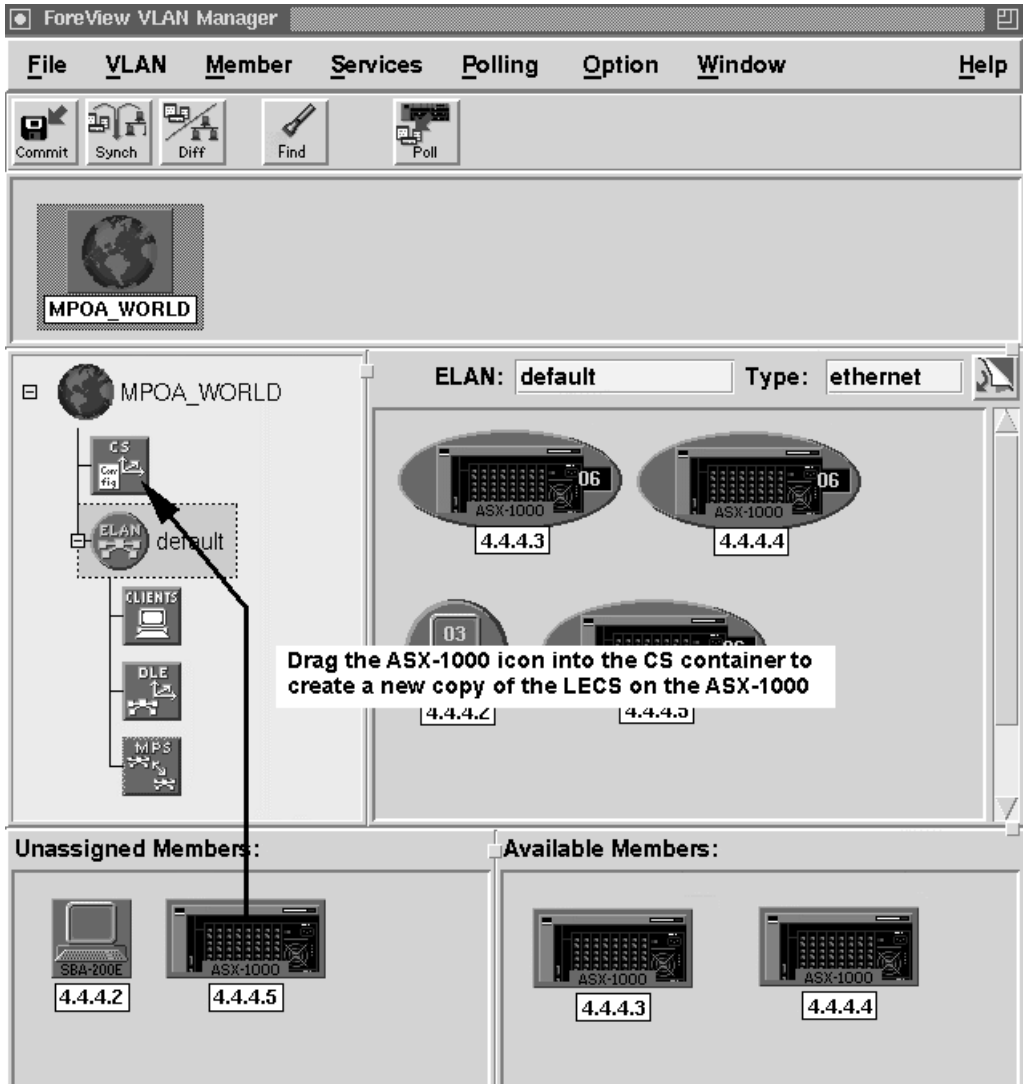


Figure 4.4 - Drag-and-Drop to Add a New Configuration Server

4.3 Managing VLANs With the GUI

The center portion of the VLAN Manager's user interface is the managed VLANs area, where all the VLANs in the selected domain are listed.

- The area to the left shows a domain tree, a hierarchical listing of all the VLANs in the selected domain.
- The area to the right shows the members in a selected VLAN. Each member icon indicates the selector byte on which the LEC is running. (Multiple LECs can run on a single host. Each LEC on the host is differentiated by selector byte, the final byte in the ATM address of the host.)

Figure 4.5 shows the `default` ELAN. The ELAN icon for `default` is highlighted, showing the members of the ELAN. The icons for some members are round, indicating that they are active clients discovered through polling and have not been configured. If you configure a member represented by a round icon, by editing its properties or using the **`(Re)Assign`** command on the **`Members`** menu, the icon changes from round to rectangular.

You can add members and LANE servers to the VLANs by dragging icons from the Unassigned Members and Assigned Members areas at the bottom of the Main window to the appropriate icon in the VLAN tree.

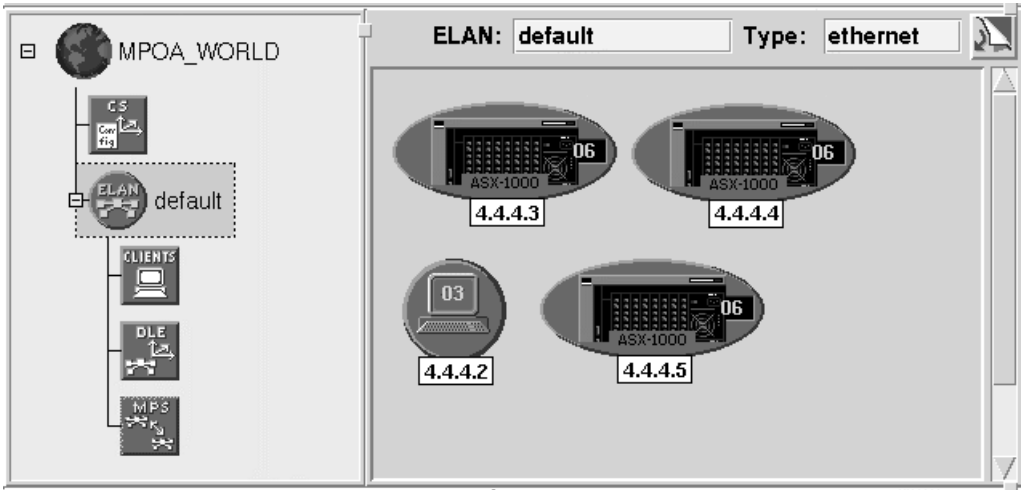
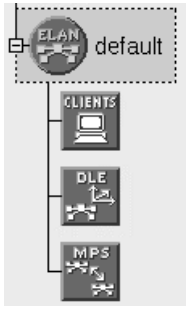
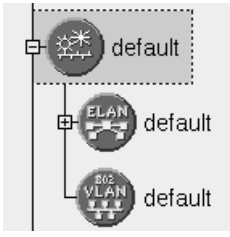


Figure 4.5 - Managed VLANs Portion of the Main Window

Three types of VLANs are supported ELANs, 802-style VLANs, and Hybrid VLANs. Refer to "Types of VLANs" on page 1-1 for a description of these types of VLANs.

The icons that appear grouped beneath a VLAN icon in the domain tree depend on whether the VLAN is an ELAN, an 802-style VLAN, or a hybrid, as described in Table 4.3.

Table 4.3 - Container Icons Appearing in Domain Tree

VLAN Type	Container Icons Displayed
Emulated LAN (ELAN) 	CLIENTS, which contains the members of the ELAN. To add clients to the ELAN, you can drag-and-drop an icon from the members area of the main window to the CLIENTS icon. DLE, which contains the Distributed LAN Emulation servers for the ELAN. To add LANE servers to the ELAN, you can drag-and-drop an icon from the members area of the main window to the DLE icon (or use the **`Manage LANE Services`** option on the **`Services`** menu). The member must be a machine capable of running services. MPS, which is not supported in this release of VLAN Manager.
802-style 	There are no sub-level icons below the 802-VLAN icon. The 802-VLAN icon acts as a container icon for the ES-3810 edge devices that make up the VLAN. To add devices to the 802-style VLAN, you can drag-and-drop ES-3810 icons to the 802 icon. For each edge device in the 802-style VLAN you must specify the ports that are members of the VLAN. For the 802-style VLAN as a whole you must specify MAC addresses that are members of the VLAN, for a MAC-based VLAN.
Hybrid 	ELAN icon, which contains the CLIENTS, DLE, and MPS container icons described above. 802-VLAN icon, which contains the members of the VLAN, as described above.

Double-click on a VLAN icon to launch the Properties dialog box through which you can modify the services for the VLAN.

4.3.1 VLAN Status Colors

The color of a VLAN icon indicates the status, as determined by the most recent poll. The status of the VLAN in each device is defined as follows:

- Unreachable (unpingable) devices are assumed down.
- Devices that are reachable (pingable) but not responding to SNMP queries are also assumed to be down.
- Devices that are reachable and responding to SNMP queries, the status of the VLAN is queried from the devices.

4.3.1.1 ELAN Status

For an ELAN, the state is derived from the operating statuses of the LAN Emulation Services (LES/BUS pairs) and Multi-Protocol Servers (MPSs) for that ELAN.

Green	All services for the ELAN are up.
Yellow	One or more (but not all) of the services are down.
Red	All services for the ELAN are down.
Blue	Unknown state.
Grey	The properties or contents of the ELAN have been edited but not yet committed.

4.3.1.2 802-Style VLAN

For an 802-style VLAN, the status is an aggregate of statuses of the VLAN in all the member devices.

Green	All devices for the VLAN are up.
Yellow	One or more (but not all) of the devices are down.
Red	All devices for the VLAN are down.
Blue	Unknown state.
Grey	The properties or contents of the VLAN have been edited but not yet committed.

4.3.1.3 Hybrid VLAN

A Hybrid VLAN incorporating both an ELAN and an 802-style VLAN derives its status from its component VLAN and ELAN.

4.3.2 Member Status Colors

The color of a member icon indicates the status, as determined by the most recent poll.

4.3.2.1 ELAN Members

For an ELAN, the state is derived from the operating statuses of the LAN Emulation Client on the member.

Green The client is active in that ELAN. If the client was discovered through polling and hasn't been configured by VLAN Manager, the icon is circular. If the client was configured through VLAN Manager, the icon is square or rectangular.

Orange Conflicting active client, configured to be in one ELAN but active in a different ELAN. The icon is circular in the ELAN in which it is active and square or rectangular in the ELAN to which it is configured.

Red LEC is down or it is configured but is not reported as being active.

Blue Unknown state.

Grey The properties or contents of the LEC have been edited but not yet committed.

A host in the ELAN can have LECs in as many as 16 different LECs. The status of the member icon indicates the status of the LEC for the selected ELAN only.

4.3.2.2 802-Style VLAN Members

The status of an 802-style VLAN member is down if:

- The VLAN Manager is not able to reach the member machine.
- The VLAN Manager is not able to do SNMP queries.
- The member machine is reachable but the 802-style VLAN does not exist on the machine.

The status is up if the machine is reachable.

4.3.3 Adding New Clients to an ELAN

You can drag and drop a machine from the Unassigned Members or Available Members area of the GUI into the CLIENTS container for the ELAN to which you want to add the machine, as shown in Figure 4.6.

When you create an ELAN member on an ATM host (for instance, a Sun workstation or a Windows NT machine) or ATM switch, you are only giving permission for a LEC on that host to join the ELAN. You must explicitly enter commands on that machine to start the LEC and join the ELAN.

However, when you create an ELAN member on an ES-3810, VLAN Manager will give permission for the LEC to join the ELAN and also start the LEC (when you subsequently perform a Commit function).

VLAN Manager does not use the Automatic ELAN selection feature when it creates a LEC. It explicitly specifies the ELAN name to which the LEC will belong.

If a client has used Automatic ELAN Selection to join an ELAN, VLAN Manager will discover that client through active client discovery.

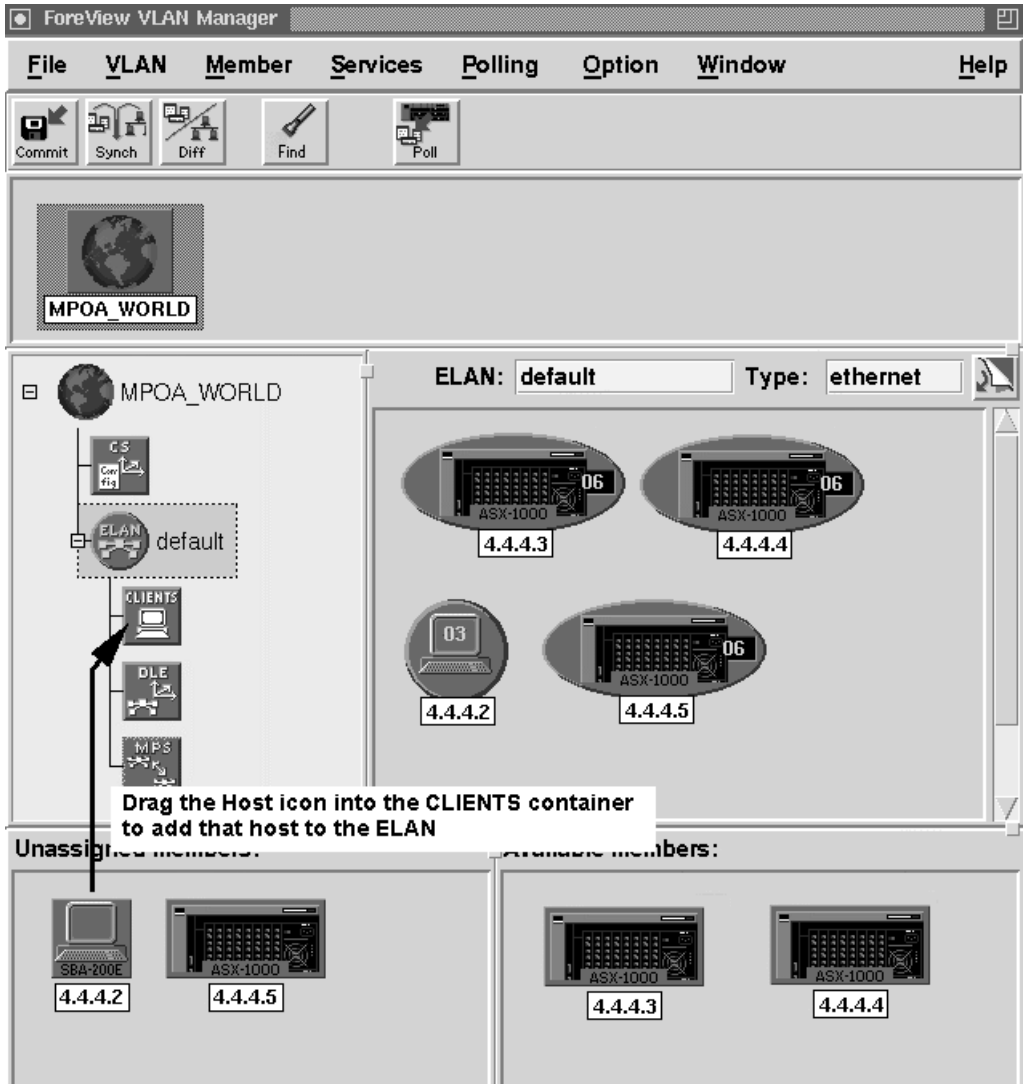


Figure 4.6 - Creating New ELAN Membership Via Drag and Drop

4.3.4 Adding New DLE Services for an ELAN

You can drag and drop a machine from the Unassigned Members or Available Members area of the GUI into the DLE container for the ELAN to which you want to add additional DLE services, as shown in Figure 4.6.

When you next perform a Commit, VLAN Manager will create a LES-BUS pair on the device that you dragged into the DLE container. If you are adding devices to an ELAN that currently only has one device configured as a DLE server, VLAN Manager will check that all the devices in the DLE container are running *ForeThought* 5.0 software that supports DLE.

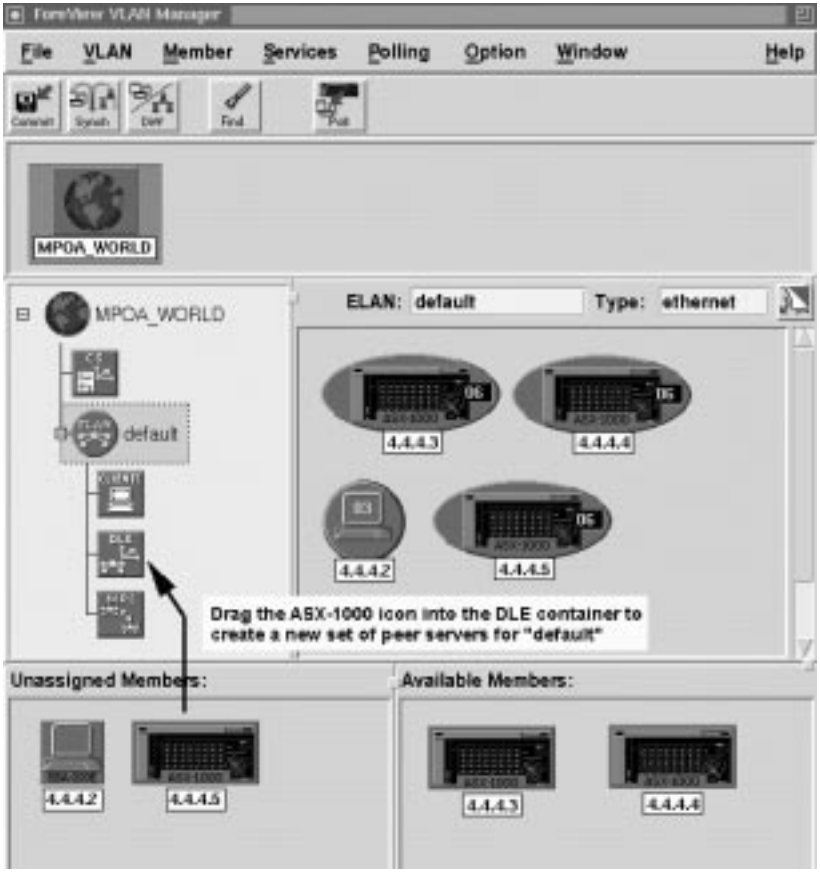


Figure 4.7 - Creating New DLE Services Via Drag and Drop

4.3.5 Adding New Members to an 802 VLAN

You can drag ES-3810s from the Unassigned Members or Available Members area of the GUI into the VLAN802 area to add ports on that device to the VLAN. Figure 4.8 shows the ES-3810 `nmtsw50e` being dragged into the MPS container for the 802 VLAN portion of the hybrid VLAN `default`. If it is a Port-based VLAN, after you drag the icon, a dialog box will appear, allowing you to specify which ports on the device should belong to the VLAN. When a Commit is performed, VLAN Manager will add the ports to the VLAN.

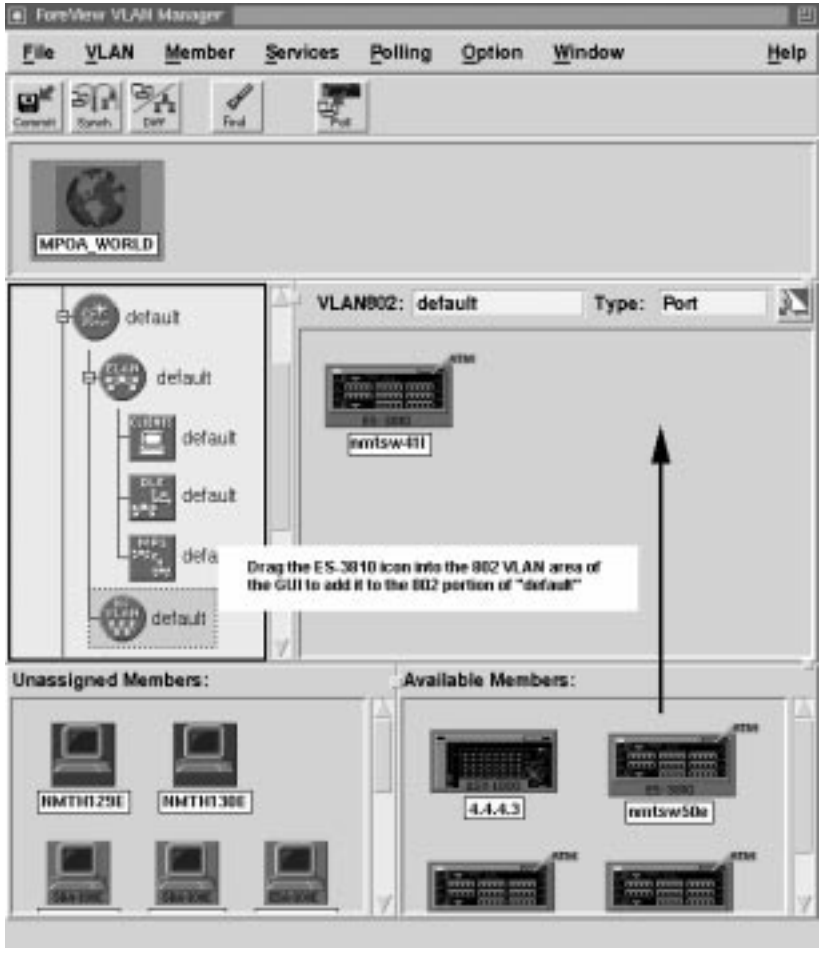


Figure 4.8 - Creating an 802-VLAN Member Via Drag and Drop

4.4 Managing Member Devices in the GUI

The bottom portion of the VLAN Manager's user interface shows all the machines known by the VLAN Manager. This area is divided into two windows.

- The window on the left lists the Unassigned Members, the current pool of machines that have not been assigned to any VLANs or ELANs. An device appears in this window if it has ***not*** been configured to join any VLANs or ELANs.
- The window on the right lists the Available Members, which are machines that have at least one of their LECs assigned to an ELAN, or have at least an 802-style VLAN configured on them. The end hosts with LECs stay in this window as long as they have at least one unassigned LEC. Most end hosts support 16 or 32 LECs, so can be assigned to 16 or 32 different ELANs[1].

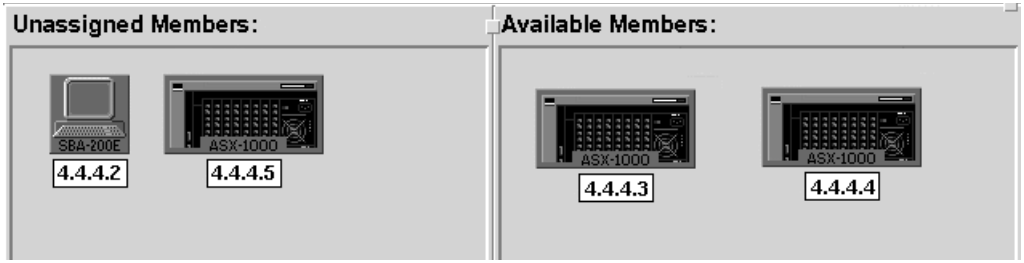


Figure 4.9 - Members Portion of the Main Windows VLAN Manager Menus

NOTE

Discovered active clients to not appear in the Unassigned Members or Available Members areas of the GUI.

1. The Windows 95 *ForeThought* driver supports four LECs. The *PowerHub* (not supported by VLAN Manager) supports 32 LECs. Other FORE devices support 16 LECs.

4.5 Modifying Parameters by Double-Clicking Icons

Modify parameters by double-clicking on an icon with the left mouse button. The result of double-clicking on different icons is described in Table 4.4.

Table 4.4 - Results of Double-Clicking on Icons

Double Clicking On...	Result
Domain Icon	Displays the Modify Domain dialog box. You can rename, add / delete and start / stop configuration servers from this dialog.
ELAN Icons	Displays the Modify VLAN dialog. From this dialog you can change hosts for LES / BUS services and modify other ELAN parameters. The same dialog is available through the VLAN->Modify menu option when an ELAN is selected (highlighted).
802-style VLAN Icons	Displays the 802VLANs dialog to modify parameters such as the type of VLAN and the MAC address list. The same dialog is available through the VLAN->Modify menu option when an 802-style VLAN is selected (highlighted).
Hybrid VLAN Icons	Toggles the display between expanding and compressing the tree containing the components of the Hybrid VLAN. Expanding a hybrid icon will cause the tree to display all the ELANs and VLANs under the Hybrid icon.
ELAN Member Icons	Displays the Modify Member dialog box to modify the LEC parameters. The same dialog is available through the Member->Modify menu option.
802-style VLAN Member Icons	***If port-based***: Displays a dialog box to modify the port list associated with the member. The same dialog is available through the Member->Modify menu option. ***If MAC-based***: Double-clicking has no effect, because there are no member-level parameters.
CLIENTs Container Icons	Displays the Modify VLAN dialog, the same result as if you double-clicked on the ELAN icon.
DLE Container Icons	Displays the Properties dialog with the Selector Byte tab displayed, listing the address of all DLE services for the ELAN.

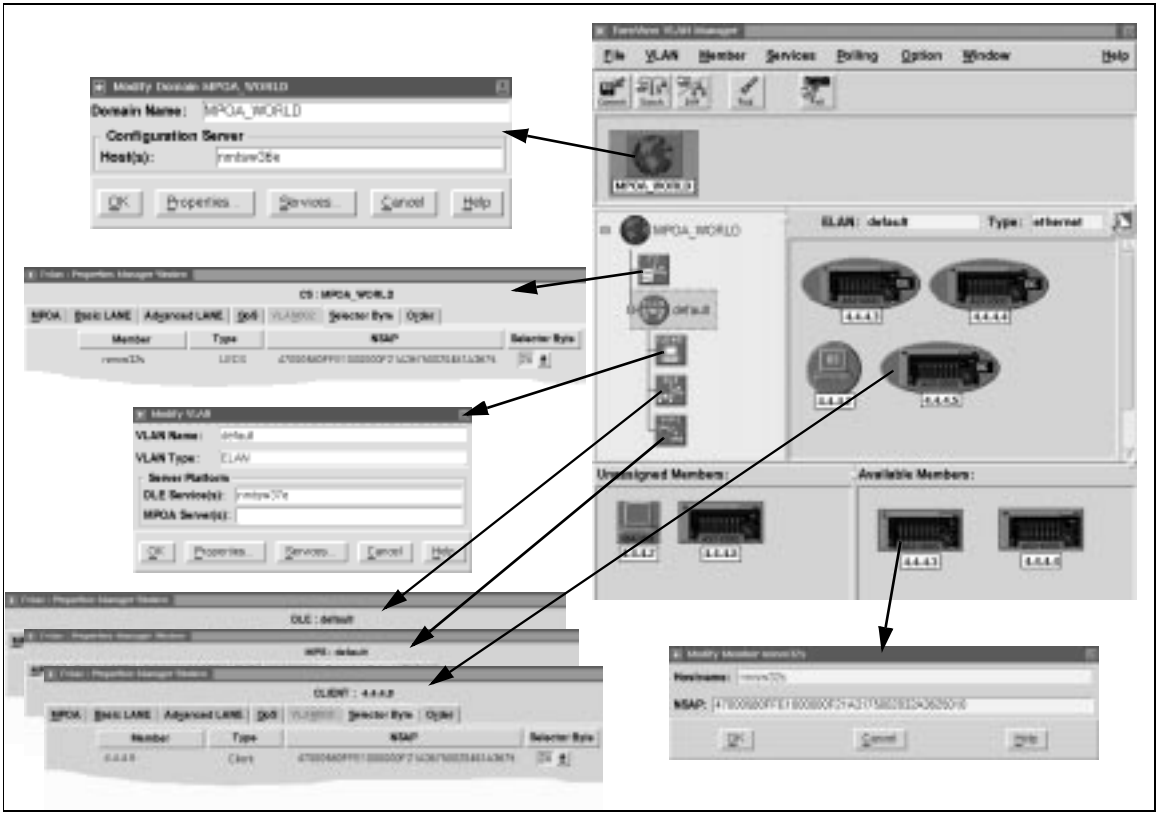


Figure 4.10 - Dialogs Displayed by Double-Clicking Icons

4.6 Using Tear-Off VLAN Client Windows

VLAN Manager allows you to "tear-off" VLAN windows containing the VLAN's client members. This allows easier management of VLANs.

To tear off the VLAN window, select the CLIENTS container icon for an ELAN or 802-style VLAN in the left side of the main VLAN Manager window. The right side of the window will contain the icons of all members of the VLAN. Then click on the tear off icon in the upper right hand corner of the members window, as shown in Figure 4.11.

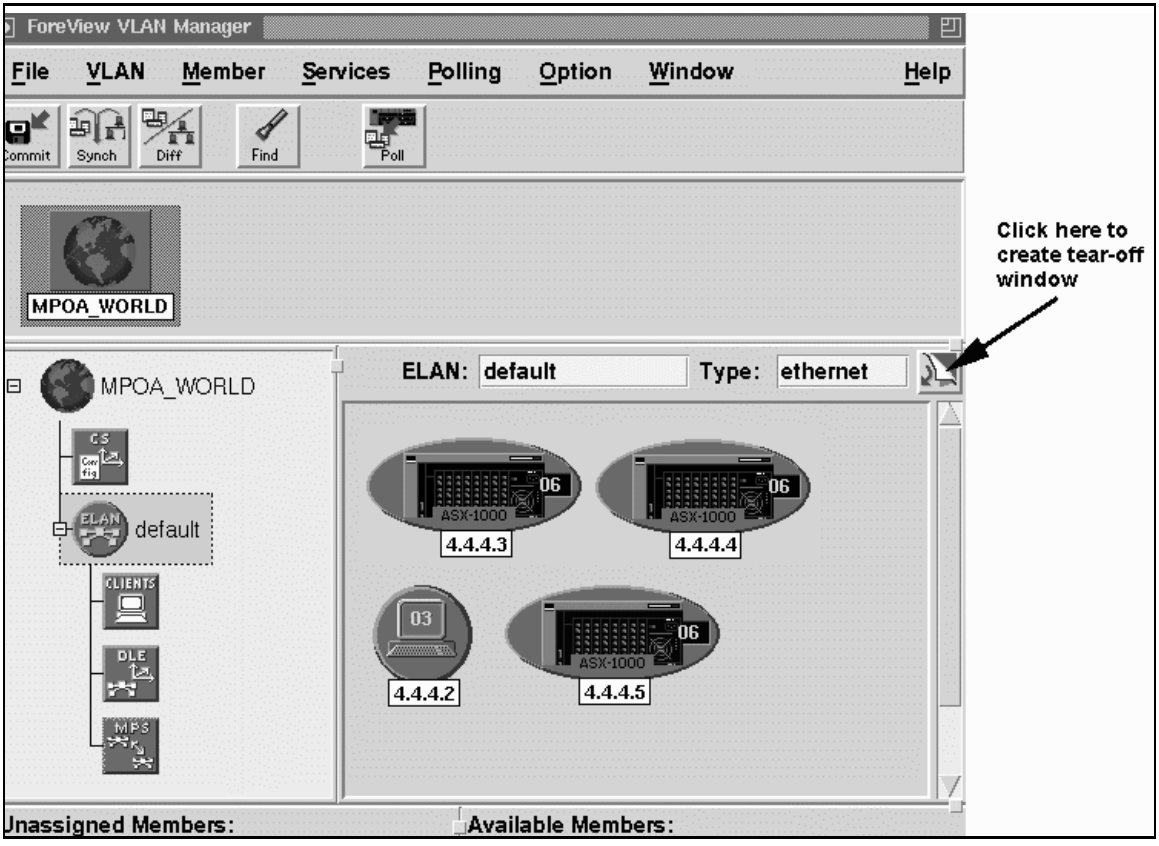


Figure 4.11 - Creating a Tear-Off Window

With multiple tear-off windows open, you can drag member icons from window to window to change membership, as shown in Figure 4.12. In the example, the host `4.4.4.2` is being moved from the ELAN `default` to the ELAN `dev`.

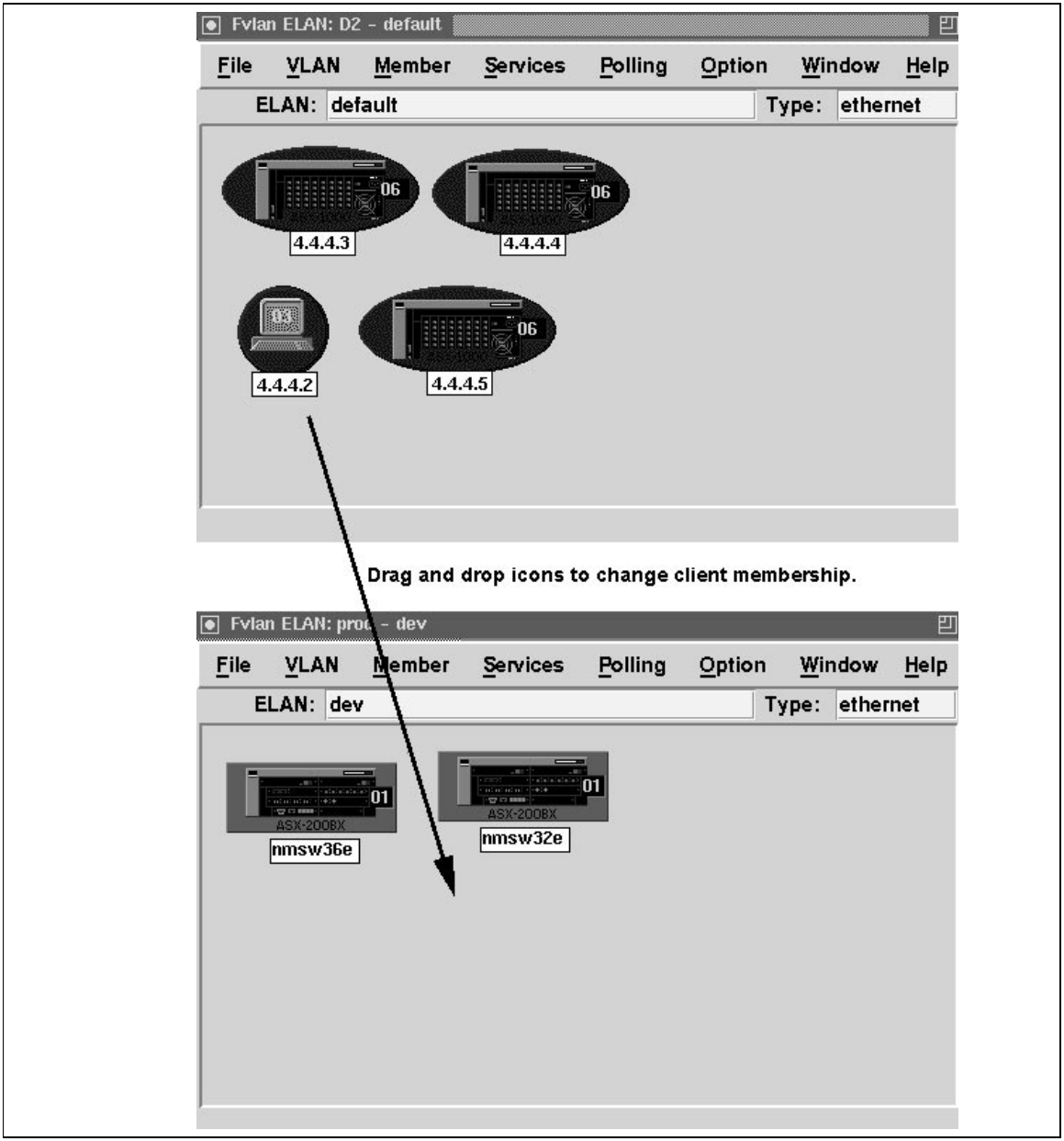


Figure 4.12 - Changing VLAN Membership by Drag and Drop

4.7 Main Menu Bar

The Main Menu bar has the following options:

File Supports menu options for creating, opening, modifying, closing, and committing administrative domains. Options to open and save a local backup of the configuration of the administrative domain are also provided.

VLAN Options for creating, modifying, deleting, and renaming VLANs are here. The same menu is used to operate on ELANs and 802-style VLANs.

Member Options for modifying, deleting, assigning, and renaming members. This menu handles operations on both LANE clients and 802-style VLAN members (ES-3810s). Allow option for creating members in the Managed Machines area.

Services Options to start and stop different LANE services.

Polling Options to set the extent of and interval between polling operations.

Option Options to configure polling and control warnings about management VLANs.

Window Provides menu options to manipulate the tear-off windows that show the members in a VLAN and an option to launch a system message log window.

Help On-line help and an “About” box with version information.

4.7.1 The File Menu

The File menu has the following options:

Create Admin Domain... Create a new administrative domain.

Open Admin Domain... Retrieve the configuration for an administrative domain from one of the machines on which the Configuration Server is running.

Modify Domain... Modify administrative domain parameters.

Commit Changes Commit changes to an administrative domain's configuration. Changes made to an administrative domain do not take effect until this option is selected.

Close Admin Domain Close an administrative domain.

Local Backup Save the configuration of an administrative domain to local file. Or, open this local file.

Close (Tear-off windows only.) This option closes the tear-off window without exiting VLAN Manager.

Exit Closes the VLAN Manager application.

4.7.2 The VLAN Menu

The VLAN menu has the following options. The Modify, Rename, and Delete options require that you first select a VLAN icon in the GUI.

Create... Create a new VLAN. This options supports creating ELANs, 802-style VLANs, and Hybrid VLANs.

Modify... Modify VLAN parameters:

- For ELANs this brings up a dialog to modify the LES/BUS services and other LANE parameters.
- For 802-style VLANs, this brings up a dialog to modify the MAC address lists or change a MAC-based VLAN to port-based.

Rename... Rename an existing hybrid VLAN. You cannot use this command to rename ELANs or 802-style VLANs.

Delete Delete a VLAN. All members must be removed before deleting a VLAN.

4.7.3 The Member Menu

The Member menu has the following options:

Create... Adds a device to the Managed Machines area.

Modify... Modify member-specific parameters for a VLAN. For an ELAN client, this provides a mechanism to override parameter values that are client-specific. For 802-style VLAN members, this allows modification of the port list associated with the VLAN.

Delete Either delete a device from the Managed Machines area or delete a device's membership from a VLAN. When a device is deleted from the Managed Machines area, it is removed from all VLANs of which it is a member.

You cannot delete the last pair of DLE services for an ELAN or active clients (indicated by round or oval icons).

Rename Rename a device. The renaming operation applies across all the VLANs of which the device is a member. It also applies to the Managed Machines area. Only valid IP host names or addresses can be used.

(Re)Assign Assign a discovered but unconfigured member to a VLAN. When you apply this command to a discovered member (which has an oval icon) the member becomes configured as a member of the VLAN and changes to a rectangular icon.

4.7.4 The Services Menu

The Services menu has the following options to allow you to start and stop and manage services. Generally, you do not need to use these options. When you perform a Commit function, VLAN Manager will automatically start or stop services as required.

These options require that you first select a VLAN or domain icon in the GUI.

Manage LANE Services — Opens the LES/BUS Servers Management Window for the currently selected ELAN.

Manage MPS Services — Opens the MPS Servers Management Window for the currently selected ELAN.

Manage LECS Services — Opens the Configuration Servers Management Window for the domain selected.

Start LANE Services — Starts the services (LES-BUS pairs) for the currently selected ELAN.

Stop LANE Services — Stops the services (LES-BUS pairs) for the currently selected ELAN.

If you stop the services for the ELAN that is providing IP connectivity for VLAN Manager (a management ELAN), you will lose connectivity and be unable to restart the services from VLAN Manager. Refer to "Specifying Management VLANs" on page 3-2 for information about management VLANs

Start LECS — Starts the LAN Emulation Configuration Server for the currently selected domain.

Stop LECS — Stops the LAN Emulation Configuration Server for the currently selected domain.

4.7.5 The Polling Menu

The Polling menu controls how often VLAN Manager polls. The following are the configurable options for polling:

No Polling	VLAN Manager will not perform any automatic polls.
5 Minutes	VLAN Manager will automatically poll every five minutes.
10 Minutes	VLAN Manager will automatically poll every ten minutes.
15 Minutes	VLAN Manager will automatically poll every fifteen minutes.
Demand Poll	Select this option to perform an immediate poll.

4.7.6 The Option Menu

The Option menu has the following options:

Configure Polling	Launches a window from which you can configure polling.
Warning Mgmt VLAN	When this option is selected, VLAN Manager issues a warning and deselects Commit tasks that would bring down VLANs that are specified as management VLANs.

4.7.7 The Window Menu

The Window menu has the following options:

Messages Window	Launches a window that contains a log of system messages.
Tear-off VLAN Window	Enabled only when a tear-off window is active. If multiple tear-off windows are active, a pick list is created that toggles between the available windows.
Main Window	This option appears only in the Window menu of the tear-off windows. This option toggles between the main VLAN Manager interface and a tear-off window.

CHAPTER 5 Using the Toolbar Functions

This chapter describes the functions provided on the VLAN Manager toolbar.

Refer to Table 5.1 to find desired information in this chapter.

Table 5.1 - Where to Find Information

For information on...	Refer to...
The Commit Function	page 5-3
The Sync Function	page 5-13
The Diff Function	page 5-19
The Find Function	page 5-21
The Poll Function	page 5-22

5.1 Using the VLAN Manager Toolbar

Tool icons are located directly below the main menu. Press a tool icon to perform the associated function, as described in Table 5.2.

Figure 5.1 - The Toolbar Icons

Table 5.2 - The Toolbar Functions

Function	Description	Refer to...
Commit 	Commits the changes you made to the GUI to the network, saving the changes to the domain's configuration file, starting and stopping services as necessary. The Commit function implements the changes that you have made on the network.	page 5-3
Sync 	Synchronizes the configuration of the administrative domain (shown in the VLAN Manager GUI) with the configuration of the network. This option is usually chosen after an administrative domain has just been opened. The configuration of the administrative domain is stored in a file, therefore it could be out of sync with network (this could happen if the user has done any modifications to the VLANs or ELANs without using the VLAN Manager).	page 5-13
Diff 	Displays the conflicts that may exist between the VLAN Manager's current view of the network and the actual network.	page 5-19
Find 	Finds a VLAN, machine, or host by name within the information available in the VLAN Manager GUI.	page 5-21
Poll 	Initiates a demand poll of the managed devices with which the VLAN Manager management station has connectivity.	page 5-22

5.2 The Commit Function

Changes made with the VLAN Manager are shown in the GUI but are not immediately implemented on the network. You must explicitly use the Commit function to implement the changes on the network. The Commit function:

1. Retrieves information from the network to determine its current configuration.
2. Determines the differences between the current VLAN Manager view of the network and the retrieved information.
3. Displays a list of tasks that VLAN Manager must perform to make the network look like the current VLAN Manager view. It allows you to view the differences in detail and edit the task list to perform only desired tasks.
4. Performs the tasks in the task list, indicating the success or failure of each operation.

Refer to "Operations Performed by the Commit Function" on page 5-9 for a description of the changes made by the Commit function.

5.2.1 Possible Loss of Connectivity During Commit

If the management station that you are using to run VLAN Manager is on an ELAN for which the Commit function must stop the services, you could lose connectivity when you perform the Commit function. VLAN Manager allows you to specify one or more VLANs as management VLANs, as described in "Specifying Management VLANs" on page 3-2.

VLAN Manager automatically deselects all tasks that involve VLANs specified as management VLANs, and also displays a prompt indicating why the tasks were deselected. You can edit the task list and re-select the items if you desire.

5.2.2 Performing the Commit Function

To perform the Commit function:

1. Select the Commit tool icon. The Commit window appears, as shown in Figure 5.2.

   The four icons at the top of the Configurable Commit dialog represent the four phases of the Commit function. Float the cursor on top of an icon for a balloon help window to explain the meaning of each icon. The current phase of the commit is highlighted.

Figure 5.2 - Configurable Commit Dialog

2. Select the extent of the commit operation you want to perform. You can improve the response time of the Commit function by limiting which operations you want to perform. The default is to perform a complete and comprehensive commit. These options can be configured:

   Configuration File to CSs — Saves/transfers the configuration file to the Configuration Servers defined for the domain.

   LANE Services — This option performs the following tasks:

   - Commits modifications to LANE and MPOA Services only, and saves and transfers the configuration file to the Configuration Servers.
   - Changes to 802-Style VLANs are not committed.
   - Conflicts and differences between the VLAN Manager GUI and the actual network configuration are not discovered for 802-Style VLANs.

   All (Comprehensive Commit) — The comprehensive commit, which performs all tasks in "Operations Performed by the Commit Function" on page 5-9.

3. Press the **Proceed** button. The VLAN Manager goes to the network, collects all the information, and then performs a Diff function between the current network state and the current VLAN Manager configuration. When the process is finished, the middle frame is replaced by a list of tasks which must be done to complete the commit process, as shown in Figure 5.3. The Message Logger area of the window displays information about the Commit process.

Figure 5.3 - Select Commit Tasks Window

4. Edit the task list, if desired. All tasks in the middle frame will be selected by default (with check mark besides them). You can double click on any task to de-select or reselect that task. Unselected tasks are marked “x”.

5. If desired, you can click on the **Show Diff** button to launch a Diff window showing the differences, as shown in Figure 5.4. The **Show Diff** button is enabled only if the Diff process detects differences in the states.

   To determine the differences, the Diff function compares the initial GUI view (before the you made any changes) with the network view. It makes note of any differences. It then compares these differences with changes you made prior to the Commit. If the differences don't correspond to changes you made, the differences are displayed in the Diff window.

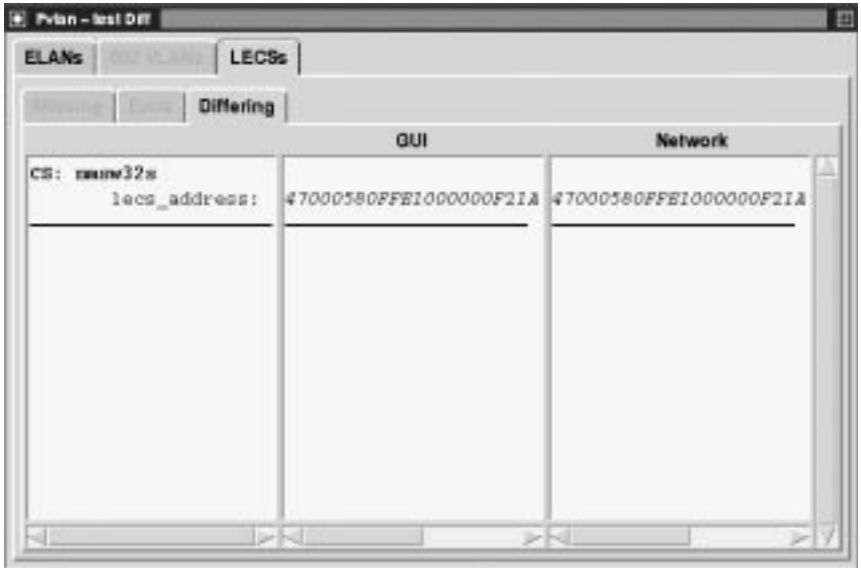


Figure 5.4 - Show Diff Dialog

6. Return to the Commit window (if you viewed the Show Diff window) and press the **Proceed** button again to execute the selected tasks.

   The result (successful / failed / partial success) is shown beside each task.

   - A green happy face indicates complete success in implementing the task.
   - A red sad face indicates failure.
   - A yellow neutral face indicates partial success, in which at least one of a series of steps required to implement the task succeeded.

   A successful Commit function is shown in Figure 5.5.

7. Select the **Close** button to close or abort the Commit function.

Figure 5.5 - Successful Commit Functions

5.2.2.1 Operations Performed by the Commit Function

In general, the Commit function performs the following operations to implement the configuration changes that have been made via VLAN Manager:

- Creates new VLANs, services, and members on the network.
- Modifies existing VLANs, services and members.
- Deletes VLANs, services and members.

The Commit function makes changes at the Configuration Server, ELAN, and 802-style VLAN level, in addition to proxy LECs on the Ethernet Edge Devices (ES-3810s). It also transfers configuration files and saves the configuration of the edge devices, if necessary, and retrieves new Port-VLAN mappings from the network and updates the VLAN Manager GUI to reflect them.

The Commit function updates the status of devices and entities it creates or modifies, but the status of devices and entities that are not affected by the Commit are ***not*** updated in the GUI.

Also, the list of unused selector bytes for devices shown in VLAN Manager is ***not*** updated.

5.2.2.2 Detection of NSAP Address Changes

Before the Commit, VLAN Manager determines if the NSAP addresses of any devices have changed, indicating that the devices have been moved to a different switch port.

5.2.2.3 LECS Operations

For Configuration Server-related operations, the Commit function:

- Starts the LECS on all of the specified Configuration Server machines, if necessary
- Modifies the LECSs on the specified Configuration Server machines, if necessary.
- Stops the LECS on deleted Configuration Server machines.
- Updates the status of created and modified servers.

Commit will transfer configuration files and save configurations as necessary:

- Transfers the latest `LECS.CFG` file to the specified Configuration Server machines.
- Saves the changes to the configuration files on ES-3810 edge devices, if this option was selected for the Commit.

See “Administrative Domains” on page -2. for more information about Configuration Servers.

5.2.2.4 ELAN Operations

For ELAN-related operations, the Commit function:

- Creates and starts DLE services as necessary.
- Creates and starts MPS servers as necessary.
- Determines appropriate NSAP addresses for the LANE services.
- Modifies DLE parameters as necessary.
- Deletes DLEs from specified machines as necessary.
- If the following parameters are changed, the Commit function stops the old LANE services and starts new services with the updated parameters:
  - LES-BUS machine name
  - LES-BUS NSAP address
  - DLE peer list
  - LAN type
  - Maximum frame size
  - Forward registration TLV flag
- If a new LES-BUS peer was added, the Commit function restarts the peer LES-BUS pairs.
- If you assigned a selector byte (for DLE services) which is not available on the device, the Commit succeeds with another available selector byte and the GUI is updated to reflect the new selector byte.
- For deleted ELANs, the Commit function stops the LANE services and deletes all LESs and proxy LECs for the ELANs. See Chapter 6 for more information on modifying ELANs and members of ELANs.
- Updates the status of created and modified services and members

5.2.2.5 802-Style VLAN Operations

For 802-style VLAN-related operations, the Commit function:

- Creates the specified 802-style VLAN on all the ES-3810 edge devices as necessary.
- Modifies the properties of the 802-style VLANs if necessary.
  - For port-based 802-style VLANs, the Commit function:
    - Adds newly assigned ports on a specific member.
    - Deletes de-assigned ports on a specific member.
  - For MAC-based 802-style VLANs, the Commit function:
    - Propagates the newly added MAC address to all the member switches
    - Propagates the deleted MAC address to all the member switches.
  - For PortMAC-based 802-style VLANs, the Commit function performs the port-based and MAC-based actions.
- Removes 802-style VLANs from the deleted members as necessary.
- Removes ports or MAC addresses from 802-style VLAN members as necessary.
- Updates the status of all new and modified 802-style VLANs and members.

5.2.2.6 Proxy LEC Operations

For proxy LEC-related operations, the Commit function:

- Creates new proxy LECs on the specified ES-3810 edge devices.
- Modifies the proxy LECs as necessary.
- Modifies the ELAN - 802-style VLAN links as necessary.
- Deletes proxy LECs on the specified ES-3810 edge devices as necessary.
- Updates the status of all new and modified proxy LECs.

Refer to “Proxy LAN Emulation Client (Proxy LEC)” on page 2-3 for more information on proxy LECs.

5.2.3 Possible Loss of Connectivity

If differences are found between the VLAN Manager GUI and the actual network configuration, the Commit function attempts to modify the network configuration to match the VLAN Manager's configuration. To do this, the VLAN Manager may have to stop some of the LANE services and start the services with the new parameters.

If the management station that you are using to run VLAN Manager is on an ELAN for which the Commit function must stop the services, you could lose connectivity when you perform the Commit function. VLAN Manager allows you to specify one or more VLANs as management VLANs, as described in "Specifying Management VLANs" on page 3-2.

VLAN Manager automatically deselects all tasks that involve VLANs specified as management VLANs, and also displays a prompt indicating why the tasks were deselected. You can edit the task list and select the items if you desire.

5.3 The Sync Function

The Sync function synchronizes the VLAN Manager internal view of the network (shown in the VLAN Manager GUI) with information retreived from the managed machines in the network. It is convenient to use the Sync function after an administrative domain has been opened, so that you are sure you are viewing the current state of the network.

Keep in mind the following when using the Sync function:

- VLAN Manager is only aware of the managed machines within the network.
- Incomplete information is discarded.
- The changes are made to the information in the GUI. In order to save this information you must use the Commit function.

If you use the Sync feature to bring in one or more VLANs, and then delete some of the synced-in VLANs ***prior to*** performing a Commit, the deleted VLANs don't appear in the VLAN Manager view, but are not actually deleted from the network.

This version of VLAN Manager does not support *PowerHub* edge devices. The Sync will not accept a configuration file that includes *PowerHub* devices, and will not sync in any *PowerHub*s during the Sync process.

5.3.1 Using the Sync Function

To synchronize the VLAN Manager view of the network:

1. Select the Sync function icon on the toolbar. VLAN Manager gathers information about all VLANs defined in the network.
2. If differences exist between the VLAN Manager view of the network and the information retreived from the network, you are given three choices:
   - Cancel the Sync function.
   - View the differences using the Diff window, after which you again have the option to continue or cancel the Sync function.
   - Continue the Sync function.

3. If you choose to continue the Sync function, the VLAN Manager is refreshed with the most current network information. Information from the network overrides the information previously maintained. However, if updating the information will cause a conflict, the VLAN Manager will not update the information.

5.3.2 Using Sync to Bring in a Previously Configured Network

FORE recommends that you use the Sync function when using VLAN Manager to manage a network that was already configured outside of the VLAN Manager. If you have LANE or 802-style VLANs in your network and you want to begin using the VLAN Manager, here is the procedure.

1. Create one or more administrative domains by using the **Create Admin Domain...** option under the File menu.
2. Under each administrative domain, create member icons for machines that are running LANE services by using the **Create Member...** option under the Member menu. If you have 802-style VLANs on ES-3810s that you also want to manage through the VLAN Manager, you will need to create member icons for the ES-3810s also.
3. Now, press the **Sync** button on the toolbar. The VLAN Manager will bring in appropriate information from all the members regarding the services and clients.
4. All LANE parameters (except LAN Type, Maximum Frame Size, and Forward Registration TLVs) will be overridden by defaults when you perform the Sync function. To re-establish the LANE parameters overrides that you had manually configured prior to using VLAN Manager, you must edit the LANE parameters within VLAN Manager:
   a. Select the ELAN icon in VLAN Manager.
   b. Select the **Modify** option under the VLAN menu. The Modify VLAN dialog appears.
   c. Select the **Properties...** button. This displays the Properties Management window, through which you can edit the LANE parameters for the ELAN.
5. Press the **Commit** button on the toolbar and review the Task list, or use the Diff function to ensure that the information is, in fact, correct. You can also modify the configuration before you perform the Commit function. Once you Commit, the VLAN Manager will write out all the information to the configuration file, enabling you to manage the network through the VLAN Manager.

5.3.3 The Sync Function Process

When the Sync function is performed, in makes decisions about what to update. The conditions it uses when making these decisions are described in the following sections.

The Sync function only updates the GUI with information from the network if the information is consistent, complete, has a valid NSAP address, and does not cause conflicts with information already in the GUI.

The Sync function will ***not***:

- Bring in services or LECs running on *PowerHub* edge devices. VLAN Manager does not support *PowerHubs* in this release.
- Update the status of existing entities in the GUI.
- Bring in active clients if the clients are not in an up state.
- Update selector byte information, except for removing the selector bytes of newly imported entities from VLAN Manager's internal list of unused selector bytes.

5.3.3.1 Detection of NSAP Address Changes

Before the Sync, VLAN Manager determines if the NSAP addresses of any devices have changed, indicating that the devices have been moved to a different switch port.

5.3.3.2 LECS Information

LECSs that are found in the network, but do ***not*** exist in the GUI are not created in the GUI.

If a Configuration Server in the network is found to be running on a different selector byte than that shown in the GUI, the GUI is updated to show the new selector byte.

5.3.3.3 ELAN Information

The Sync function takes the following actions when importing ELAN information:

- If at least one LES-BUS pair for an ELAN is found in the network and that ELAN does not exist in the GUI, the new ELAN is created in the GUI. For each ELAN that is found, DLEs and MPSs in the network are created in the GUI.
- ELANs that are in the GUI, but are not found in the network, are ***not*** deleted from the GUI.
- Active clients that are joined to the newly created ELAN are created in the GUI.
- For newly created ELANs, all the parameters other than `lan_type` & `maximum_frame_size` (plus a few DLE related parameters) will have the default values. For existing ELANs, the following parameters have different values in the GUI than the network, then the information from the network is used:
  - LAN Type

  - Maximum Frame Size
  - Anycast Address
  - Mpoa Keepalive Time
  - Mpoa Keepalive Lifetime
  - If no `lan_type` & `maximum_frame_size` information was retrieved from the network then the default values (ethernet, 1516) will be used.
  - If only `lan_type` information was retrieved, then the default maximum frame size value of 1516 is used for Ethernet and 4544 is used for Token Ring.
- Consistency check for DLE: If ALL of the known peers do not have the SAME value for `anycast_address`, `mps_flag`, `lan_type`, and `maximum_frame_size` then the data is considered to be inconsistent and is not synchronized into the GUI.
- Consistency check for MPS: If ALL of the known peers do not have the SAME value for `mpoa_keepalive_time` and `mpoa_keepalive_lifetime` then the data is considered to be inconsistent and is not synchronized into the GUI.
- ELANs that are in the GUI and in the network are updated with information from the network.
  - DLE and MPS parameters are updated in the GUI if different in the network.
  - DLE services and MPSs newly found in the network are added to the GUI.
  - DLE services and MPSs that are in the GUI but not found in the network are ***not*** deleted from the GUI.
- The ELAN status is determined and displayed in the GUI.

5.3.3.4 802-style VLAN Information

The Sync function takes the following actions when importing 802-style VLAN information:

- 802-style VLANs that are newly found are created in the GUI.
- 802-style VLANs that are in the GUI but not found in the network are ***not*** deleted from the GUI.
- 802-style VLANs that are in the GUI and in the network are updated with information from the network.
  - 802-style VLAN members newly found in the network are added to the GUI.
  - 802-style VLAN members that are in the GUI but not found in the network are ***not*** deleted from the GUI.
  - If the VLAN Type or MAC address list parameters have different values in the GUI than the network, then the information from the network is used.
  - Port list information is updated on a per member basis. (Ports on the ES-3810 edge devices that belong to the 802-style VLAN)
  - Subnet-based VLANs are not supported by VLAN Manager and are not be synchronized into the GUI view.

5.3.3.5 Proxy LEC Information

If a proxy LEC was found in the network (ES-3810) ***and*** the corresponding ELAN exists in the GUI, then a new client is created as a member of the ELAN for which it is proxying.

Proxy LECs that are in the GUI but not found in the network are ***not*** deleted from the GUI.

Proxy LECs that are in the GUI and in the network are updated with information from the network. If the following parameters have different values in the GUI than the network, then the information from the network is used:

- NSAP address of the Proxy LEC
- Virtual Port number of the Proxy LEC

5.3.3.6 Hybrid VLAN Information

The Sync function takes the following actions when importing Hybrid VLAN information:

- After the new ELANs, 802-Style VLANs, and Proxy LECs are created in the GUI, the VLAN Manager decides the new grouping of ELANs and 802-style VLANs based on the available information.
- The Proxy LEC information retreived from the network indicates which ELANs it should join and 802-style VLANs for which it will act as a proxy. This information is compared with the information in the GUI for possible conflicts.

  If the above operation indicates possibility of conflict, no change is made to the 802 VLAN under consideration. If no conflict is detected then VLAN Manager decides if it should:

  - Create new Hybrid VLANs. If it creates new Hybrid VLANs, it will assign generated names, such as `VLM_HYB#`, where # is a unique number within the configuration. After the Sync you can rename the VLAN as desired.
  - Move any 802-style VLANs from one Hybrid to another Hybrid VLAN, or create an 802-style VLAN in an existing Hybrid VLAN. New ELAN / 802-style VLAN associations are created by moving 802-style VLANs (and members) from one Hybrid to another.

ELANs and VLANs that are in the GUI (user created but did not commit as yet) but not in the network are not overwritten.

5.4 The Diff Function

The Diff function shows the differences between the VLAN Manager's current view of the network and the actual network topology. You can perform the Diff function as an independent function by pressing the Diff icon in the toolbar. It is also implemented as part of the Commit and Sync functions, described in "The Commit Function" on page 5-3 and "The Sync Function" on page 5-13.

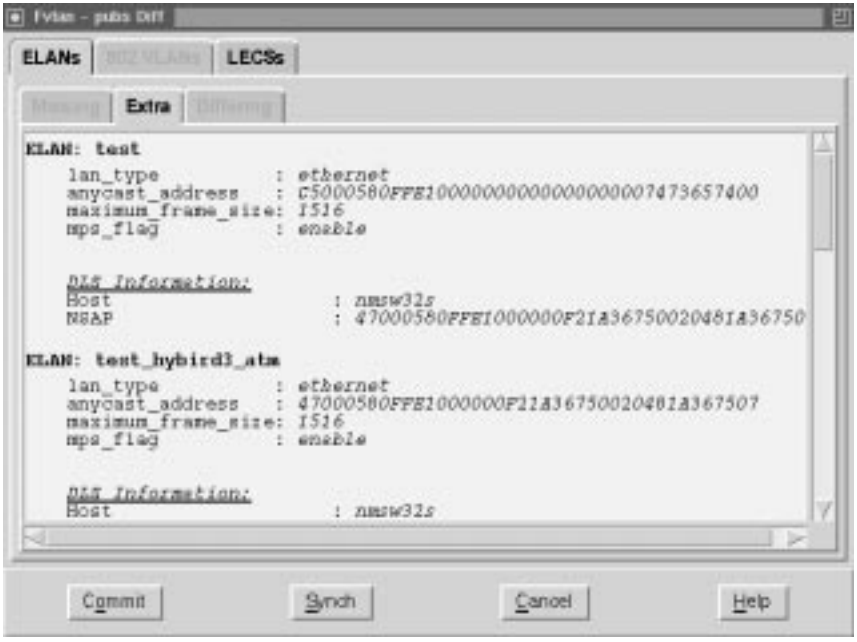


Figure 5.6 - The Diff Function Dialog Box

The Diff Function dialog box organizes differences into three categories:

ELANs This tab lists details about any ELAN differences.

802_VLANs This tab lists details about any 802-style VLAN differences.

LECs This tab lists details about any LEC differences.

The differences are further organized within each category:

Missing Items that have previously been committed through VLAN Manager but now aren't on the network.

Extra Items that aren't in the current VLAN Manager view of the network but were just discovered by the Diff function.

Differing Items that match but have different parameter settings than those in the current VLAN Manager view.

From the Diff Function dialog box you can perform a Commit or Sync function by using the **`Commit`** or **`Sync`** buttons.

VLAN Manager has a limited capability to automatically detect changes in the physical configuration of a device. NSAP address changes are detected. However, the procedure is best-effort. After the NSAP address changes are detected, you must use the Commit function to restart services if necessary and transfer the configuration file to the LECS.

5.5 The Find Function

The Find function searches the information maintained by the VLAN Manager for a particular domain, VLAN, ELAN, or member. It produces a list of items matching the search criteria.

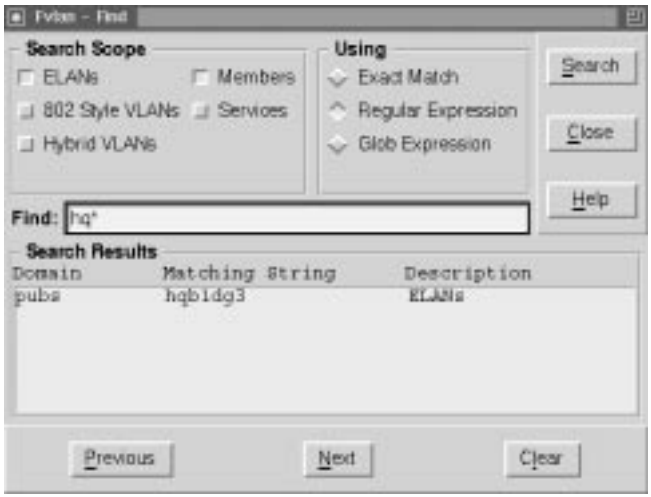


Figure 5.7 - The Find Function Dialog Box

The Find dialog box has the following parameters to define the search:

Search Scope This area allows you to specify the type of item you are searching for. You can specify as many options as desired.

Using This area allows you to specify the type of expression you are using to search.

Exact Match - Specifies that the searched-for item must exactly match the string entered in the Find field.

Regular Expression - Specifies that you can use UNIX-type search expressions in the string entered in the Find field.

Glob Expression - Specifies that the searched-for item must only approximately match the item entered in the Find field.

5.6 The Poll Function

The Poll function is equivalent to the Demand Poll command in the Polling menu. Polling uses SNMP to discover the status of items in the network.

VLAN Manager updates the following information during the polling cycle:

- Status of Hybrid VLANs:
  - ELAN status (LES / BUS Status)
  - VLAN status (the status of individual members)
- Status of unassigned / available members
- Status of Administrative Domains
  - Individual Configuration Server(s) status
- Unused selector bytes available on the machines shown in the Unassigned and Available Members portions of the Main Window.
- Unused Ethernet ports available on ES-3810s in the Unassigned / Available Members portions of the Main Window

The port list of 802-style VLAN members is ***not*** updated during a polling cycle.

5.6.1 Configurable Polling Operation

The VLAN Manager provides a method to improve the response time of the polling operation via a configurable interface that allows you to select one or more options for polling. To configure the polling options, select **`Options -> Configure Polling`** to launch the following dialog.

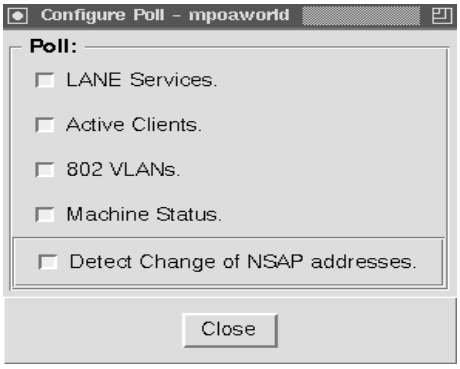


Figure 5.8 - Configurable Polling Dialog

You can select one or more, or none, of these options.

LANE/MPOA Services — Poll all LANE and MPOA related services: Configuration Servers for the domain, Distributed LAN Emulation (DLE) and MPOA Servers.

LANE/MPOA Services & Active Clients — Poll all LANE and MPOA related services, plus discover clients (LECs) connected to the ELAN services.

LANE/MPOA Services & 802-Style VLANs — Poll all LANE and MPOA related services and LECs, plus 802-Style VLANs.

Detect Change of NSAP Address — Poll all LANE and MPOA related services, LECs, 802-Style VLANs, and plus for changes of NSAP addresses.

All (Comprehensive Polling) — Includes all items mentioned in the above, plus the status of hosts / machines in the Managed Machines Area (i.e. Unassigned and Available Machines).

5.6.2 Active Client Discovery

In *ForeThought* 5.0, VLAN Manager can discover active but unconfigured clients in an ELAN through polling. In previous versions, the VLAN Manager only displayed the configured clients (i.e. clients explicitly configured in the LECS). A client might be active but not configured if the client was started on a host but not specified in the domain configuration.

Whether a client is configured or not can be easily determined by the shape of the client icons: a configured client is represented by a square and an active client that is not configured is represented by a circle, as shown in Figure 5.9.

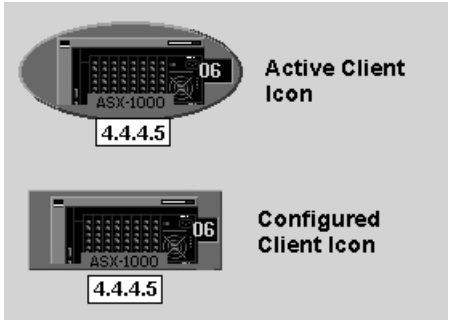


Figure 5.9 - Active and Configured Client Icons

The active clients in an ELAN can be discovered only if the machine running the LES has *ForeThought* 5.0 software. If the ELAN is using DLE, the list of active clients includes all active clients found in all the peer LESs.

Information regarding discovered active clients is not be saved in the domain configuration unless you subsequently assign the client to an ELAN. The machines associated with the discovered active clients are not displayed in the Managed Machines portion at the bottom of the Main Window unless they have already been created by the user.

To configure the discovered active clients, select their icons (using a bounding box, if desired, to select multiple icons simultaneously) and use the **(Re)Assign** option of the **Members** menu.

CHAPTER 6 Configuring VLANs and Members

This chapter provides information on how to use the VLAN Manager to create VLAN configurations and to store this information in configuration files. The VLAN Manager retrieves configuration information from the machine where the LECS is running, or from a local file. The machine on which the configuration file resides must be a host or a switch which supports FORE System's LANE and MPOA services.

Refer to Table 6.1 to find desired information in this chapter.

Table 6.1 - Where to Find Information

For information on...	Refer to...
Configuring Administrative Domains	page 6-2
Configuring ELANs	page 6-7
Configuring 802-style VLANs	page 6-8
Configuring Hybrid VLANs	page 6-9
Creating a New VLAN	page 6-10
Modifying a VLAN	page 6-12
Configuring Members	page 6-13

6.1 Administrative Domains

This section describes procedures for creating and modifying administrative domains. A domain represents a segregation of VLANs defined by a network administrator. A domain is an administrative tool and must be maintained by the network administrator. There is nothing to prevent additional VLANs from joining the domain, either through VLAN Manager or through manual configuration.

The top portion of the VLAN Manager's user interface lists all the domains currently managed by the VLAN Manager. Because each domain is served by one or more configuration servers, you must specify one or more valid hosts on which the LECS can run when you create a domain.

6.1.1 Creating New Administrative Domains

To create a new administrative domain, select **`File -> Create Admin Domain...`** from the main menu to launch the dialog box as shown in Figure 6.1.

Figure 6.1 - Administrative Domain Dialog

Provide the following information to create a new administrative domain:

Domain Name — The logical name of the administrative domain being created. There should be only one administrative domain per physical network.

Configuration Server Host(s) — The name or IP address of the machine where the LECS will run. The configuration of the related VLANs for this domain is stored on this machine. Redundant configuration servers can be set up by entering list of host names or IP addresses separated by commas or spaces.

Properties Select this button to launch the domain property window to configure advanced parameters for the domain, such as MPOA, LANE, QoS, or DLE.

Services Select this button to launch the Services Management Window for the domain, where you can start, stop, add, or delete any LECS for the domain. (This option is not available when you are creating a new domain.)

After you click on **OK** in the New Admin Domain dialog, and subsequently perform a Commit operation, the following steps are performed by the VLAN Manager:

- The VLAN Manager creates a new `LECS.CFG` file for the domain on the machines specified as configuration servers.
- A configuration server is started on each of the specified machines.

If the network administrator does not intend to use LANE, the "Configuration Server Host Name" entry (in the New Admin Domain dialog) can be left empty. However, the administrator must be sure to save the configuration to a local file.

- The VLAN Manager stores the configuration file on the specified host.

6.1.2 Modifying Existing Administrative Domains

To modify an administrative domain, select **`File -> Modify Domain...`** from the main menu or double-click on the domain icon in the top portion of the main VLAN Manager GUI. For example, to modify the administrative domain **`test`**, double-click on the domain icon to launch the Modify Domain dialog as shown in Figure 6.2.

Figure 6.2 - Modify Domain Dialog

The **`Properties...`** button provides advanced parameters available for the selected domain. The Properties Manager window is a common interface for setting all advanced parameters in the virtual LAN for the following categories - MPOA, LANE, Advanced LANE, QoS, Selector Byte, 802-style VLANs, and Match Ordering. Depending upon the launch point, one of the categories will be selected and its parameters displayed. See “Double Click Icons to Manage Properties” on page 7-2.

The **`Services...`** button launches the Services Management Window with for this domain. You can create or delete a LECS and change the selector bytes. See “Services Management” on page 7-20.

NOTE

VLAN Manager does not automatically read in a manually edited `LECS.CFG` file if that file lacks key information required by VLAN Manager.

6.1.3 Opening Administrative Domains

Open an existing administrative domain to view the configuration of existing VLANs, to modify domain parameters, and to create or modify new VLANs and members for an existing domain. To open an administrative domain, select **`File -> Open Admin Domain...`** from the main menu.

NOTE

This version of VLAN Manager does not support *PowerHub* edge devices. VLAN Manager will not accept a configuration file that includes *PowerHub* devices.

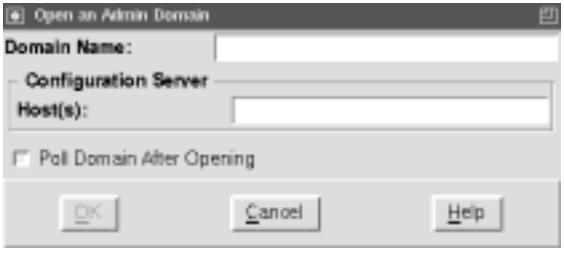


Figure 6.3 - Open Admin Domain Dialog Box

Provide the following information to open an administrative domain:

Domain Name — The logical name of the administrative domain being opened.

Configuration Server Host Name/IP Address — The name, or IP address, of the machine where the configuration information (file) is located. If there are multiple servers configured for this domain, giving any one name is sufficient.

Poll After Opening — Check this box if you want VLAN Manager to perform a poll on the domain after it is opened. This will determine the status of devices in the domain, and is advisable, but can be time-consuming depending on the size and state of the network.

After pressing the **OK** button, the VLAN Manager retrieves the configuration file and updates the main VLAN Manager GUI to reflect the newly opened domain. The VLAN Manager also verifies the current network configuration with the configuration file. Any inconsistencies are indicated by status colors, as described in “Domain Status” on page 4-4.

6.2 VLAN Configuration and Management

This section describes procedures for configuring VLANs and ELANs. The center-left portion of the VLAN Manager's user interface is the Managed VLANs area, where all the VLANs in the active domain are listed in a domain tree. Three types of VLANs are supported:

- ELANs, which are emulated LANs supporting Ethernet 802.3 or Token Ring.
- 802-style VLANs, either port-based or MAC-address based.
- Hybrid VLANs, with a mixture of clients. In Hybrid VLANs, both ELAN and 802-style VLAN parameters areas are enabled. This type of VLAN is internal to the VLAN Manager. It provides a means of grouping an ELAN with 802-style VLANs to create a single broadcast domain.

The system administrator is responsible for ensuring that there is proper connectivity between the components of 802-style VLANs and ELANs.

When a VLAN is initially created, it is classified as a Hybrid VLAN by default. However, you may change the type of VLAN by selecting either the **ELAN** or **VLAN802** option when configuring the VLAN.

6.2.1 ELAN Configuration

This section describes how to use the VLAN Manager to configure and maintain an ELAN over an ATM network. An ELAN provides communication of user data frames among all members of the ELAN, similar to a physical LAN. One or more ELANs may run simultaneously (and independently) on the same network domain. The VLAN Manager supports the configuration of Ethernet ELANs or Token Ring ELANs.

The minimum requirements to configure an Ethernet or Token Ring ELAN are:

- A device running DLE services (a LES-BUS pair). These are created by VLAN Manager when you create an ELAN.
- A valid LAN Emulation Configuration Server (LECS). This is created by VLAN Manager when you create a domain.

Later, LAN Emulation Clients (LECs) can be added as members of the various ELANs. Each member LEC resides on an ATM host system (PC, UNIX workstation, switch, or bridge device such as an ES-3810). Most FORE ATM host systems support up to 16 LECs each.

6.2.1.1 Token Ring ELANs

The VLAN Manager supports emulation of Token Ring (IEEE 802.5) ELAN services. However, Token Ring LECs can not be created on the switch. In the current switch software release, the LECS and LES-BUS pair may reside either in a *ForeRunner* switch or in a UNIX workstation running Solaris 2.x.

6.2.2 802-style VLAN Configuration

VLAN Manager allows the network administrator to configure and maintain IEEE 802-style VLANs operating on FORE's ES-3810. An 802-style VLAN is a collection of hosts attached to one or more ES-3810s grouped into a single broadcast domain.

When creating the VLAN, you can specify the type of 802-style VLAN:

- Port-based - For each ES-3810 in the VLAN, you specify which ports belong to the VLAN. A port can only belong to one VLAN, but different ports can belong to different 802-style VLANs.
- MAC address-based - For the VLAN as a whole, you specify which MAC addresses belong to the VLAN. MAC address-based VLANs are supported on ES-3810s only.
- Port and MAC addressed based - For the VLAN as a whole, you specify which MAC addresses belong to the VLAN. Also, for each ES-3810 in the VLAN, you specify which ports belong to the VLAN.

To specify the type, when you create the VLAN as described in "Creating a VLAN" on page 6-10, select the **Properties** button and then specify the type (and, if selecting MAC address-based, specify the MAC addresses that will belong to the VLAN).

6.2.3 Hybrid VLAN Configuration

VLAN Manager allows the network administrator to configure and maintain Hybrid VLANs, which include ELANs and 802-style VLANs. A hybrid VLAN is maintained within VLAN Manager as a way to organize ELANs and 802-style VLANs into a single broadcast domain. A proxy LEC (Refer to "Proxy LAN Emulation Client (Proxy LEC)" on page 2-3 for a description) running on the ES-3810 provides connectivity from the 802-style VLAN to the ELAN.

The system administrator is responsible for ensuring that there is proper connectivity between the components of 802-style VLANs and ELANs.

Hybrid VLANs contain a mixture of client members running on ATM host systems (including PCs, UNIX workstations, switches) and edge devices such as the ES-3810. Because of this mixture of clients, both ELAN and 802-style VLAN parameters are enabled.

When a Hybrid VLAN is configured, the VLAN Manager creates a top level icon with two associated second level icons, one representing ELAN entities (for this release Ethernet) and the other representing 802-style VLAN entities.

When configuring a Hybrid VLAN, remember the following points:

- ATM host system LECs, when added to a Hybrid VLAN, become members of the ELAN portion of the Hybrid VLAN.
- When an ATM-connected ES-3810 is dragged and dropped onto a Hybrid icon, a proxy LEC is created in the associated ELAN, and an instance of the device is created in the associated 802-style VLAN with a link to the ELAN.
- A Hybrid VLAN can include only one ELAN. However, it can include multiple 802-style VLANs.

6.2.4 Creating a VLAN

To create a VLAN in an administrative domain, select **`VLAN -> Create...`** from the main menu to launch the Create VLAN dialog as shown in Figure 6.4.

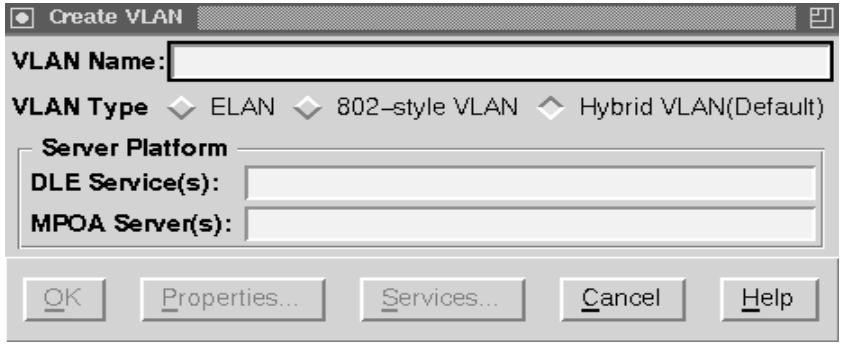


Figure 6.4 - Create VLAN Dialog

Provide the following information to create a new VLAN:

VLAN Name — Name of the VLAN which is being created. The VLAN Manager will check for duplicate names in the current administrative domain.

VLAN Type — Select the type of VLAN, either ELAN, 802-style VLAN, or Hybrid VLAN. The default is Hybrid VLAN.

Server Platform — The names, or IP addresses, of the machines where the DLE services for this ELAN will run. The MPOA Servers field is not supported in this release of VLAN Manger

NOTE

VLAN Manager fully supports the intelligent BUS if the LES-BUS pair is using the same selector byte. VLAN Manager does not support:

- LES-BUS pairs running on NSAP addresses differing in the first 19 bytes
- LES-BUS pairs running as separate processes using different selector bytes on the same machine.

Properties Select this button to launch the VLAN property window to configure advanced parameters for the VLAN, such as MPOA, LANE, QoS, or DLE.

- For 802-style VLANs, select this button to change the VLAN type from the default of Port-based.

Services Select this button to launch the Services Management Window to manage DLE services.

If `802-style VLAN` is selected, the DLE and MPS(s) entries are disabled and the contents cleared. If the type is changed to a non-802-style VLAN, the original contents are re-enabled.

In the case of ELANs and Hybrid VLANs, after a Commit function VLAN Manager attempts to start the LES-BUS pair on each host entered in the DLE Service(s) field.

The VLAN Manager will check if DLE is supported on the specified hosts; if not, the corresponding server won't be started. If DLE is not supported on the host, it will start a *ForeThought* 4.x.x LES-BUS pair.

For Hybrid VLANs, you must enter a host in the DLE Services(s) field. A Hybrid VLAN enclosure will be created and you can then drag and drop 802-style VLANs and ELANs onto the Hybrid VLAN.

For ELANs, you must enter a DLE host name to enable the **OK** button.

6.2.5 Modifying VLANs

To modify a VLAN, select a VLAN icon, the select **`VLAN -> Modify`** from the main menu or double-click on the VLAN icon in the center portion of the VLAN Manager main window. When modifying a VLAN, a dialog box similar to Figure 6.5 is presented.

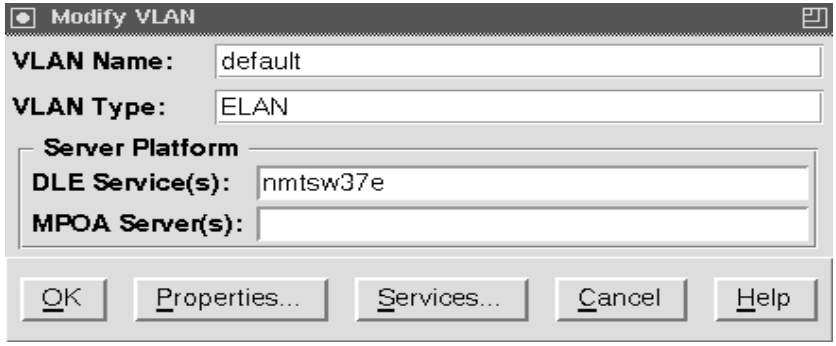


Figure 6.5 - Modify VLAN Dialog

The **`Properties...`** button provides advanced parameters available for the selected VLAN. The Properties Manager window is a common interface for setting all advanced parameters in the virtual LAN for the following categories:

- MPOA parameters for the Multi-Protocol Server and Multi-Protocol Clients
- Basic and Advanced LANE parameters.
- Selector Byte
- QoS parameters.
- 802-style VLAN parameters.
- Match Ordering.

Depending upon the launch point, one of the categories will be selected and its parameters displayed. See “Double Click Icons to Manage Properties” on page 7-2.

The **`Services...`** button launches the Services Management Window with for this VLAN. You can

- Create and delete services.
- Start and stop services.
- Change the selector byte assigned to services.

See “Services Management” on page 7-20.

6.3 VLAN Member Configuration and Management

This section describes procedures for creating and modifying members belonging to VLANs (either ELANs, 802-style VLANs, or Hybrid VLANs).

6.3.1 Creating a Member

Use the **Member** menu from the main menu bar to create, modify, delete, or rename an ELAN member. To create an new Member in a VLAN (ELAN, 802-style VLAN, or Hybrid VLAN) select **Member -> Create...** from the main menu to launch the Create Member dialog as shown in Figure 6.6.

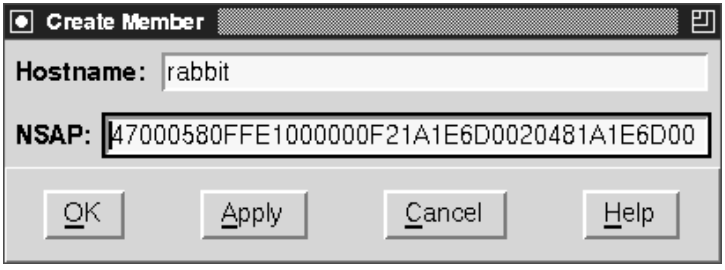


Figure 6.6 - Create Member Dialog

Provide the following information to create a new member:

Hostname Enter the host name or IP address of the host being added. The VLAN Manager will try to contact the host to determine its type. If the host is unreachable it is assumed to be an end station and not a manageable device such as an ATM switch or an ES-3810 Ethernet switch.

NSAP The VLAN Manager queries the host to determine its NSAP address. If the VLAN Manager is unable to obtain the address, then you must enter it manually.

There must be an existing LEC on an ES-3810 for VLAN Manager to retrieve the NSAP address.

The qaa0 interface must be running on a UNIX workstation for VLAN Manager to retrieve the NSAP address.

Press the **OK** button after filling in the required values. A member icon representing the host appears in the "Unassigned Members" area.

NOTE

At this point, no member has been added to any VLAN. You must explicitly drag and drop the member icon onto the desired VLAN to assign the client to the VLAN.

6.3.1.1 ELAN Member Creation

When you create an ELAN member on an ATM host (for instance, a Sun workstation or a Windows NT machine) or ATM switch, you are only giving permission for a LEC on that host to join the ELAN. You must explicitly enter commands on that machine to start the LEC and join the ELAN.

However, when you create an ELAN member on an ES-3810, VLAN Manager will give permission for the LEC to join the ELAN and also start the LEC (this occurs when you perform a Commit function).

6.3.2 Modifying an Unassigned Member

To modify a member that has not yet been assigned to a VLAN, select the member icon in the Unassigned Members area of the main window and choose the **`Member->Modify...`** menu option from the main menu. The Modify Member dialog appears, as shown in (Double-clicking on the member icon also brings up the Modify Member dialog.)

The only parameter you can change is the NSAP address of the device.

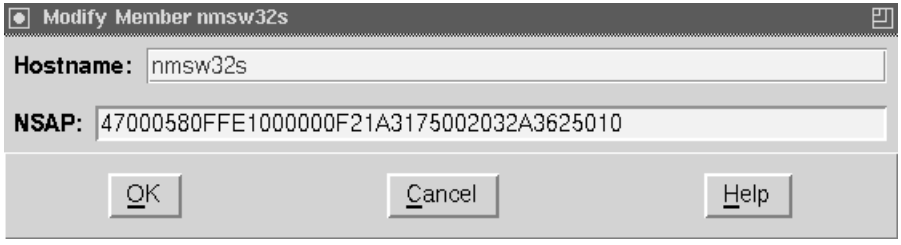


Figure 6.7 - Modify Member Dialog Box

6.3.3 Modifying an ELAN Member

To modify a member in an ELAN, select the member icon and choose the **`Member->Modify...`** menu option from the main menu. The Properties Manager window is displayed for the member, with the Selector Byte tab selected. Through this window you can edit all parameters for the member. The fields in this window are described in Section 7.1.

The modifiable parameters of a member are dependent on the type of VLAN to which the member belongs, either an ELAN or an 802-style VLAN. Any of the configuration parameters can be altered on an individual basis for each member.

NOTE

Double-clicking on a member icon also will bring up the Modify Member dialog.

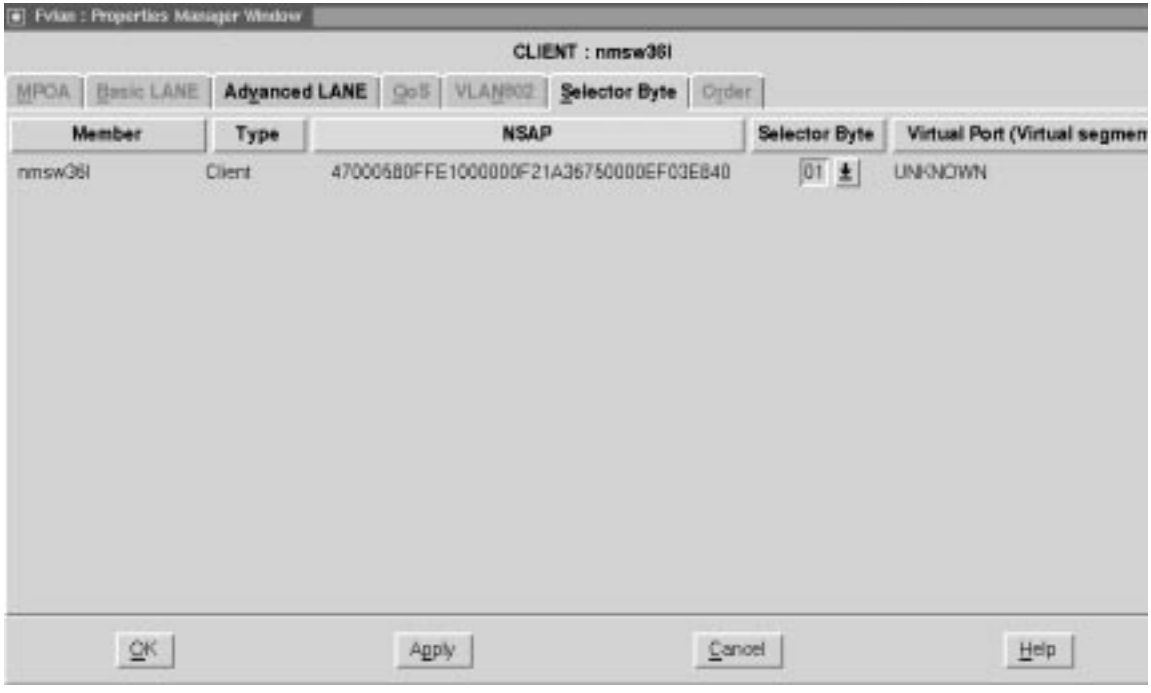


Figure 6.8 - Properties Manager for Member

6.3.4 Modifying an 802-style VLAN Member

Only ES-3810s can be assigned to 802-style VLANs.

6.3.4.1 Port-Based or PortMAC-Based 802-style VLAN Members

To modify a member of a Port-based or PortMAC-based 802-style VLAN, single-click on the member icon and select **`Member -> Modify...`** from the main menu. (Double-clicking on an 802-style VLAN member icon also brings up the Modify Member dialog.) The Configure Ethernet Switch dialog box appears, as shown in Figure 6.9. In this dialog box, you can edit which ports of the device are members of the VLAN.

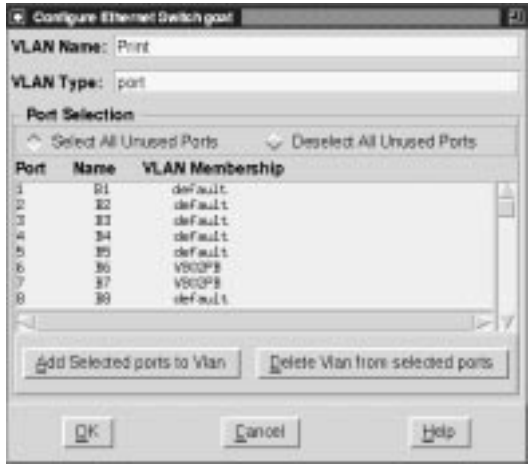


Figure 6.9 - Modifying an 802-style VLAN Member

In the Configure Ethernet Switch dialog box, the VLAN Name and VLAN Type are displayed for reference and cannot be edited. The listbox shows all the ports on the device and indicates the VLAN to which each port belongs. You can modify the list by adding or deleting ports to and from the VLAN.

For the ES-3810, each port can belong to only one ELAN. However, in the case of a PortMAC VLAN, the MAC address membership overrides the Port address membership. For example, a port (Port 6) may explicitly belong to VLAN A. But the device attached to Port 6 might have a MAC address that explicitly belongs to a different VLAN, VLAN B. In this case the traffic from the device on Port 6 is considered to be for VLAN B and not VLAN A.

6.3.4.2 MAC-Based 802-style VLAN Members

MAC-based 802-style VLAN members have no configurable parameters. For MAC-based VLANs, the parameters are set at the VLAN level by selecting the VLAN icon and selecting **`VLAN -> Modify...`** from the main menu. (Double-clicking on an 802-style VLAN icon also brings up the 802VLAN properties tab.) You can then edit the list of MAC addresses that comprise the ELAN.

6.3.4.3 Hybrid 802-style VLAN Members

802-style VLAN members that are part of a Hybrid VLAN are modified in the same way as 802-style VLAN members that are not in hybrid VLANs, with the addition of proxy LEC information.

Figure 6.10 - Modify Dialog for a Port-Based Hybrid VLAN Member

For MAC-based 802-style VLANs there is no member-specific information.

6.4 Deleting VLANs and Members

To delete a member from a VLAN:

1. Select the member from the Managed VLANs portion of the VLAN Manager.
2. Select **`Member -> Delete`** from the main menu.

When you delete a member, the VLAN Manager performs the following actions:

- The icon representing the member is removed from the Managed VLANs area.
- When a member is deleted from a 802-style VLAN, the MIB entry corresponding to the member machine is deleted the next time you perform the Commit function.

To delete a VLAN in the active administrative domain:

1. Select the VLAN from the Managed VLANs portion of the VLAN Manager.
2. Make sure all of the members of the VLAN have been deleted.
3. Select **`VLAN -> Delete...`** from the main menu.

When you delete a VLAN, the icon representing the VLAN is removed from the Managed VLANs area, and when you subsequently perform a Commit function, VLAN Manager takes the following actions:

- If the deleted VLAN is an ELAN, then all the DLE services (LES-BUS pairs) are stopped.
- If the deleted VLAN is a 802-style VLAN, then any entries corresponding to the VLAN in all the member devices are deleted.
- The VLAN is deleted from the configuration file.

CHAPTER 7 Editing VLAN Properties

This chapter provides information on how to use the VLAN Manager to edit VLAN properties at three levels:

- The Configuration Server level (parameters set at this level apply to all VLANs in the domain, unless overridden at the VLAN or member level).
- The VLAN level (parameters set at this level apply to all members of the VLAN, unless overridden at the member level).
- The Member level.

VLAN Manager uses a common interface to edit these parameters, regardless of the level at which they are being edit. Not all parameters can be set at all levels. VLAN Manager cannot edit the properties of active clients (members that are discovered by VLAN Manager but are not configured in the Configuration Server.

This chapter also describes how to use the VLAN Manager dialogs to configure the Configuration Servers and DLE services. (However, FORE recommends maintaining services through the GUI, as described in Chapter 4.)

Refer to Table 7.1 to find desired information in this chapter.

Table 7.1 - Where to Find Information

For information on...	Refer to...
Configuring MPOA Properties	page 7-5
Configuring LANE Properties	page 7-7
Configuring Advanced LANE Properties	page 7-9
Configuring QoS Properties	page 7-11
Configuring 802-Style VLAN Properties	page 7-15
Configuring the Selector Byte	page 7-17
Configuring Matching Order	page 7-19
Configuring Server Properties	page 7-20

7.1 Double Click Icons to Manage Properties

Modify parameters by double-clicking on an icon with the left mouse button. The result of double-clicking on different icons is described in Table 7.2 and Figure 7.1.

Table 7.2 - Results of Double-Clicking on Icons

Double Clicking On...	Result
Domain Icon	Displays the Modify Domain dialog box. You can rename, add/delete and start/stop configuration servers from this dialog. By clicking on the Properties... button you can edit the parameters for the domain.
ELAN Icons	Displays the Modify VLAN dialog. From this dialog you can change hosts for LES/BUS services and by clicking on the Properties... button you can edit the parameters for the domain. The same dialog is available through the VLAN->Modify menu option when an ELAN is selected (highlighted).
802-style VLAN Icons	Displays the 802VLANs dialog to modify parameters such as the type of VLAN and the MAC address list. The same dialog is available through the VLAN->Modify menu option when an 802-style VLAN is selected (highlighted).
Hybrid VLAN Icons	Toggles the display between expanding and compressing the tree containing the components of the Hybrid VLAN. Expanding a hybrid icon will cause the tree to display all the ELANs and VLANs under the Hybrid icon.
ELAN Member Icons	Displays the Modify Member dialog box to modify the LEC parameters. The same dialog is available through the Member->Modify menu option.
802-style VLAN Member Icons	***If port-based***: Displays a dialog box to modify the port list associated with the member. The same dialog is available through the Member->Modify menu option. ***If MAC-based***: Double-clicking has no effect, because there are no member-level parameters.

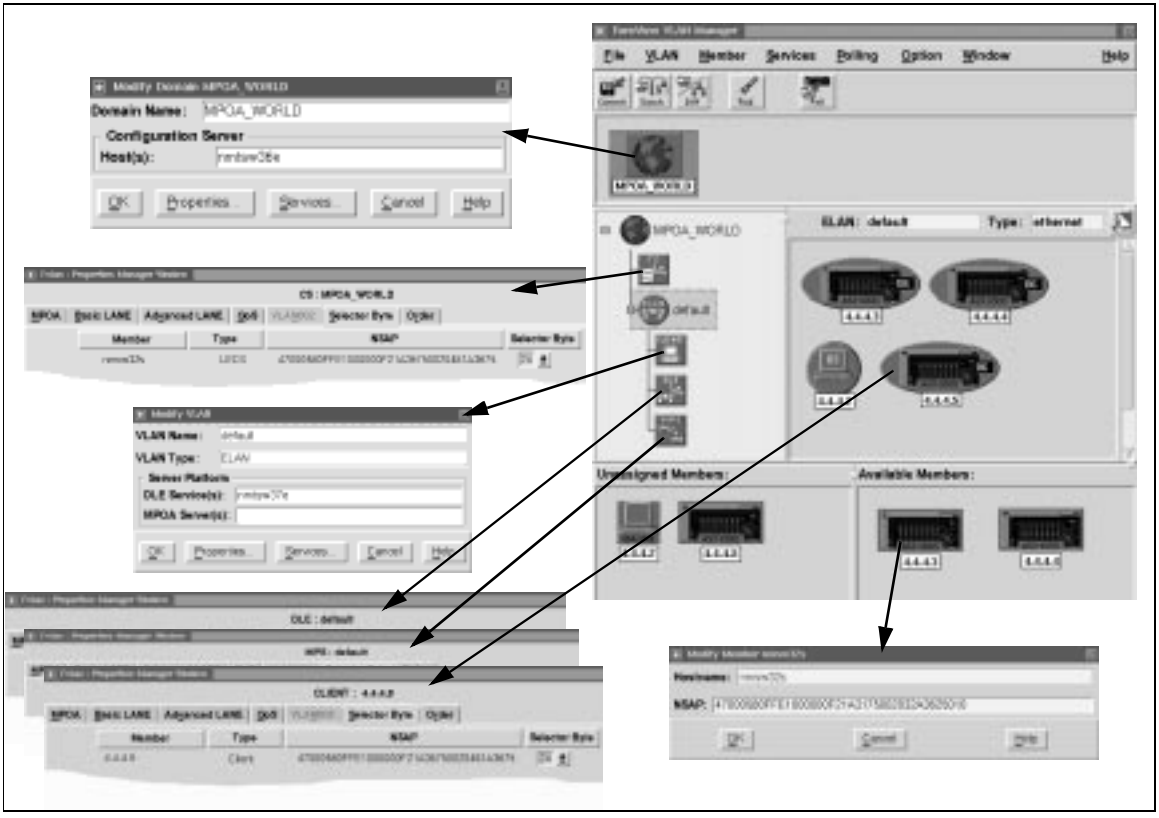


Figure 7.1 - Dialogs Displayed by Double-Clicking Icons

7.2 Properties Management

The Properties Management window, shown in Figure 7.2, appears when you click the Properties... button when creating or modifying a domain, VLAN, or member. It also appears when you double-click on a domain, VLAN, or member icon.

The Properties Management window contains the following tabs, allowing you to customize the parameters that will apply on a domain-wide, VLAN-wide, or member-only basis, depending on what you are editing:

- Edits made at the domain level (i.e. to a Configuration Server) apply to all VLANs within that domain, unless they are overridden at the VLAN or member level.
- Edits made at the VLAN level (i.e. to the LES-BUS pairs for an ELAN) apply to all members of that VLAN, unless they are overridden at the member level.
- Edits made at the member level (i.e. to a client host) apply only to that member.

Changes made with the Properties Management window are shown in the GUI but don't take effect until you perform a Commit function.

MPOA Tab — MPC and MPS parameters. The MPS parameters are not available at the member level. This tab is not available for modification when launched from a Modify 802-style VLAN dialog or when the domain has LECS software earlier than *ForeThought* 5.0.

Basic LANE Tab — ELAN and Configuration Server related parameters. This tab is highlighted when invoked from the create/modify client dialog box. This tab is not available for modification when launched from the Modify 802-style VLAN dialog.

Advanced LANE Tab — BUS, LE-ARP, and miscellaneous LANE parameters. This tab is not available for modification when launched from the Modify 802-style VLAN dialog.

QoS Tab — Legacy Application QoS parameters. This tab is not available for modification when launched from a Modify 802-style VLAN dialog or when the domain supports an old LECS version.

802-style VLAN Tab — VLAN type and MAC address specification parameters for MAC-based 802-VLANs. This tab is grayed out on a client-specific basis.

Selector Byte Tab Selector bytes for the NSAPs of the LECS, LES/BUS, LEC and MPS. This page is grayed out when launched from a Modify 802-style VLAN dialog box.

Order Tab Match-ordering list of the ELANs defined within the domain. This page is grayed out when launched from a VLAN or client (it is available only on a domain wide basis).

7.2.1 MPOA Tab

Figure 7.2 shows an example of the MPOA tab. This tab allows you to specify parameters for the MPC.

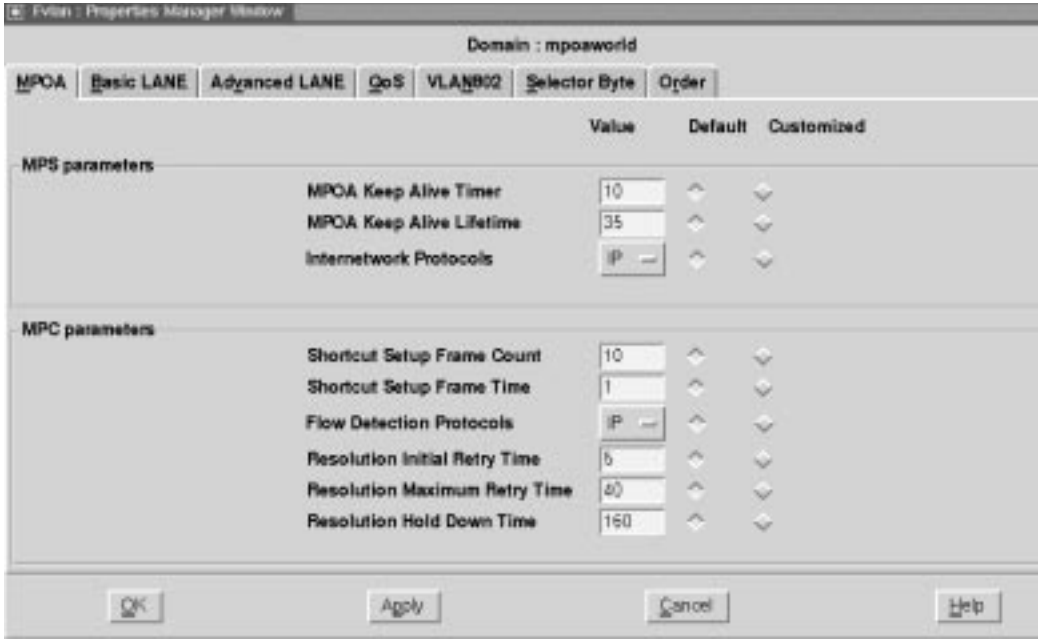


Figure 7.2 - MPOA Properties Tab

The Default column indicates that the parameter is derived from a set of defaults in the configuration file. When a default is changed, the new values will be inherited by the ELAN.

The Customized column indicates that the value is customized to the selected VLAN, domain, or member and may differ from the default.

7.2.1.1 MPC Parameters

Shortcut Setup Frame Count

Specifies the number of frames per second that a LANE/MPOA client (LEC/MPC) forwards to the same destination via the default forwarding path before which it should begin using a shortcut. The minimum number of frames is 1 frame and the maximum is 65535 frames. The minimum rate of speed at which the frames are forwarded is 1 second and the maximum is 60 seconds. The default is 10 frames per second. The range is 1 to 65535.

Shortcut Setup Frame Time

Specifies the time interval in which the Shortcut Setup Frame Count should be observed. The default is one second. The range is 1 to 60 seconds.

VCC Time-out Period

Specifies the amount of time after which a LEC/MPC should release any VCC shortcut that has been idle. The minimum is 1 minute. The maximum is unlimited. The default is 20 minutes.

Flow Detection Protocols

Specifies the set of protocols on which to perform flow detection. The default is IP.

Resolution Initial Retry Time

Specifies the initial retry time interval after which a LEC/MPC may send another MPOA Resolution Request if an MPOA Resolution Reply has not been received for the initial request. The minimum is 1 second. The maximum is 360 seconds. The default is 5 seconds.

Resolution Retry Time Maximum

Specifies the maximum retry time interval after which a LEC/MPC assumes an MPOA Resolution Request has failed. The minimum is 30 seconds. The maximum is 300 seconds. The default is 40 seconds.

Resolution Hold Down Time

Specifies the minimum amount of time to wait before re-initiating an MPOA Resolution Request after a failed resolution attempt. This value usually is greater than the Resolution_Maximum_Retry_Time. The minimum is 30 seconds. The maximum is 1200 seconds. The default is 160 seconds.

7.2.2 Basic LANE Properties

Figure 7.3 shows an example of the Basic LANE Properties tab. This tab allows you to control ELAN and LECS related parameters.

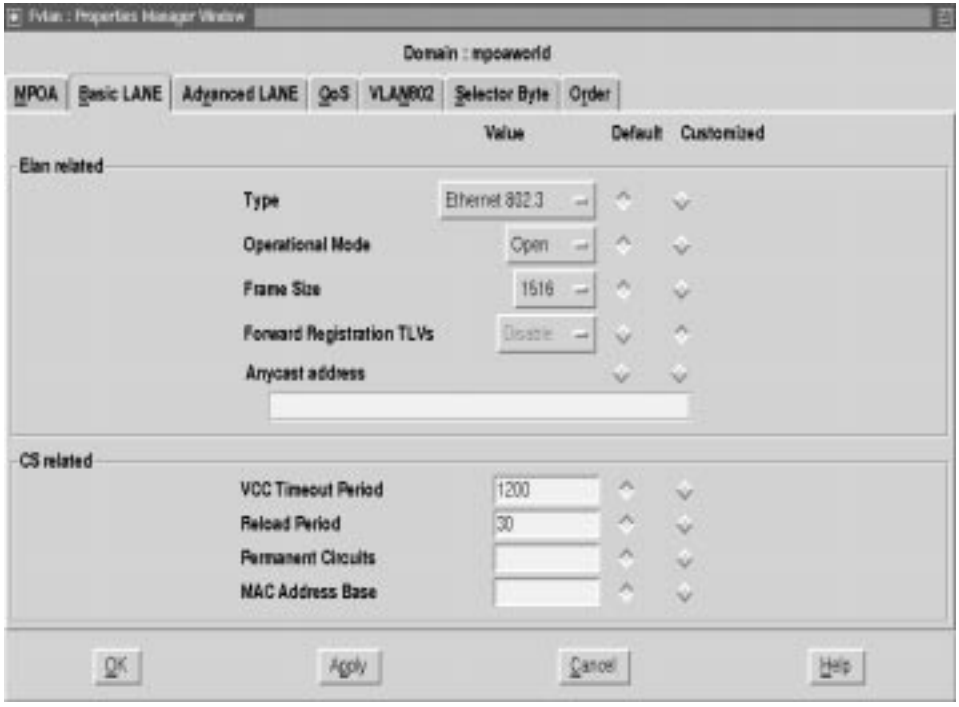


Figure 7.3 - Basic LANE Properties Tab

The Default column indicates that the parameter is derived from a set of defaults in the configuration file. When a default is changed, the new values will be inherited by the ELAN.

The Customized column indicates that the value is customized to the selected domain, VLAN, or member and may differ from the default.

The following ELAN related LANE parameters can be modified:

Type Specifies the type of ELAN that is being emulated, Ethernet or Token Ring. The default is Ethernet.

Operational Mode Specifies whether the ELAN is `Opened` or `Closed`. `Opened` indicates that any client can join the ELAN. `Closed` indicates that only clients explicitly specified in the LECS.CFG file can join the ELAN.

Maximum Frame Size Specifies the MTU size to be used by the ELAN. The default is 1516.

Forward registration TLVs? Specifies whether the corresponding field during LES creation or modification should be enabled or not. When enabled, the LES is capable of recognizing MPOA servers. The default depends on the *ForeThought* software version running on the devices running LANE services:

- If the devices are running software earlier than *ForeThought* 5.0, this field is set to `Disable` and cannot be changed.
- If the devices are running *ForeThought* 5.0 this field is set to `Enable`.

Anycast Address Specifies the anycast address to be used by the LES or multiple peers running services for the ELAN. The anycast address is generated automatically if a host is specified. FORE recommends that you do not edit the anycast address.

7.2.3 Advanced LANE Properties

Figure 7.4 shows an example of the Advanced LANE Properties tab. This tab includes parameters for the BUS, LE-ARP entries, and miscellaneous parameters.

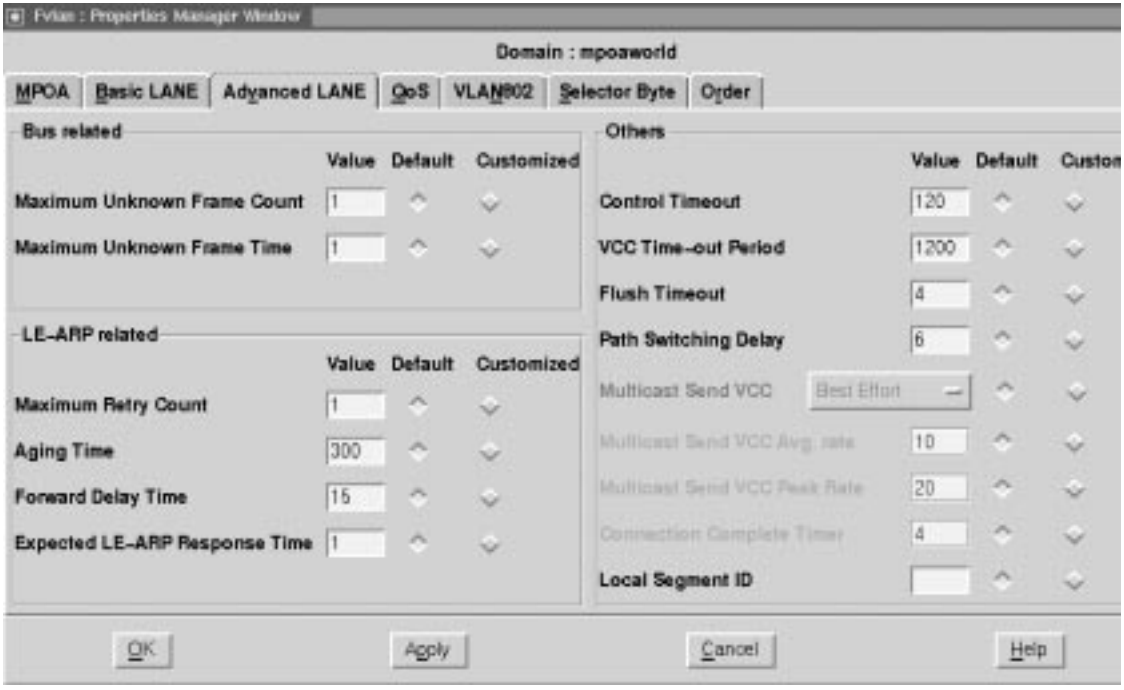


Figure 7.4 - Advanced LANE Properties Tab

The Default column indicates that the parameter is derived from a set of defaults in the configuration file. When a default is changed, the new values will be inherited by the ELAN.

The Customized column indicates that the value is customized to the selected domain, VLAN, or member and may differ from the default.

The following BUS related LANE parameters can be modified:

Maximum Unknown Frame Count — Limits the number of unicast frames sent to the BUS. The default is 1 frame.

Maximum Unknown Frame Time — Limits the number of unicast frames sent to the BUS to the specified number of seconds. The default is 1 second.

The following LE-ARP related LANE parameters can be modified:

Maximum Retry Count — Limits the number of LE_ARP requests. The default is 1.

Aging Time — Specifies the period that LE_ARP cache table entries remain valid, in seconds. The default value is 300 seconds.

Forward Delay Time — Specifies the timing out of non-local ARP cache entries in seconds. The default value is 15 seconds.

Expected LE ARP Response Time — Specifies the maximum time a LEC expects an LE_ARP request/response will take, in seconds. The default value is 1 second.

The following miscellaneous LANE parameters can be modified:

VCC Timeout Period — Specifies the length of time that an idle data connection remains open before being closed. The default value is 1200 seconds.

Flush Timeout — Specifies the maximum time a LEC expects an LE_FLUSH request/response will take. The default is 4 seconds.

Path Switching Delay — Minimum time between switching BUS and data paths, in seconds. The default value is 6 seconds.

Multicast Send VCC Type — Specifies the multicast send mode. Options are Best Effort, Variable, and Constant.

Mcast Send VCC Avg Rate — Specifies the forward and backward Sustained Cell Rate when setting up Multicast Send VCC, if using Variable bit rate coding.

Mcast Send VCC Peak Rate — Specifies the forward and backward Peak Cell Rate when setting up Multicast Send VCC while using either Variable or Constant bit rate coding.

Connection Complete Timer — Specifies the time period in which data or READY_IND is expected, in seconds. The default is 4 seconds.

Local Segment ID — The segment ID of the Token Ring ELAN. The range is 0 - ffff. This field applies only to Token Ring ELANs.

7.2.4 QoS Properties

Figure 7.5 shows an example of the QoS Properties tab. Quality of Service (QoS) for legacy applications.

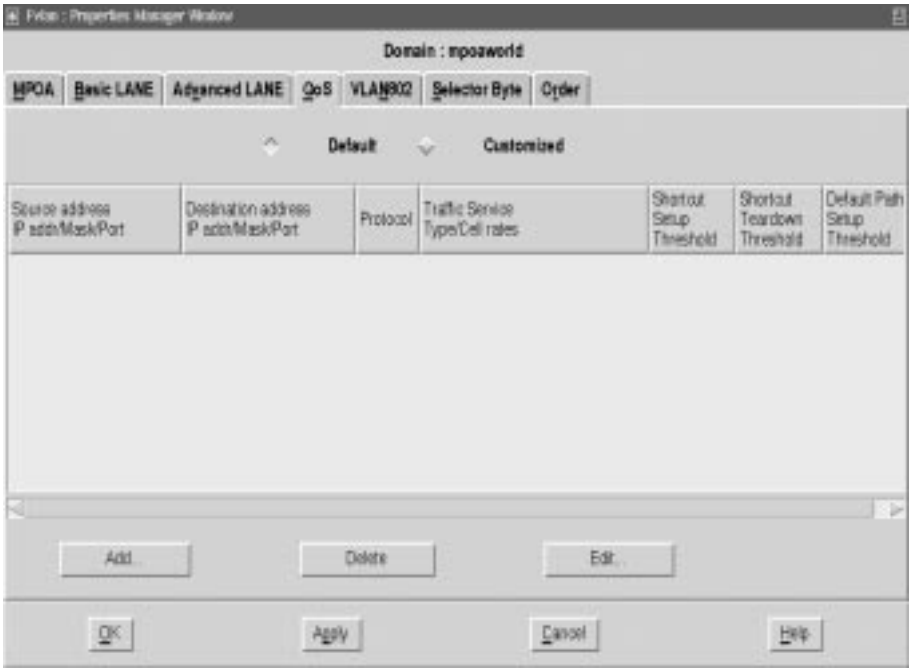


Figure 7.5 - QoS Properties Tab

The Default field indicates that the QoS is derived from a set of defaults in the configuration file. When a default is changed, the new values will be inherited by the ELAN.

The Customized column indicates that the value is customized to the selected domain, VLAN, or member and may differ from the default.

The following are the QoS parameters:

Source Address The IP address, mask, and port of the source of the IP flow. For the source mask, the number of significant bits in the source address. A prefix of 32 means the entire address is significant. A prefix of 0 is used to match all addresses. The source port can be a wild card (*).

Destination Address — The IP address, mask, and port of the destination of the IP flow. For the destination mask, the number of significant bits in the source address. A prefix of 32 means the entire address is significant. A prefix of 0 is used to match all addresses. The destination port can be a wild card (*).

Protocol — Either TCP, UDP, ICMP, or IGMP.

Traffic Service — Specifies the Quality of Service (QoS) class for this flow:

- Shared specifies a UBR connection will be shared among all flows to the same destination.
- UBR specifies a non-shared UBR connection. The format is `UBR <rate>`.
- CBR specifies a CBR connection. The format is `CBR <rate>`.
- VBR specifies a VBR connection. The format is `VBR <rate> <rate> <burst> <rate> <burst>`.
- NRT-VBR specifies a non-real time VBR connection. The format is `NRT-VBR <rate> <rate> <burst> <rate> <burst>`.
- ABR specifies an ABR connection. There is no format defined for ABR.

Shortcut Setup Threshold — Traffic threshold to be reached before a dedicated VCC is established.

Shortcut Teardown Threshold — Traffic threshold below which the default forwarding path should be used.

Add Button — Click this button to add a new QoS specification. The Legacy Application QoS window is displayed, described in "Adding or Editing a QoS Flow Descriptor" on page 7-13.

Delete Button — Click this button to delete the selected QoS in the list.

Edit... Button — Click this button to edit the selected QoS in the list. The Legacy Application QoS window is displayed, described in "Adding or Editing a QoS Flow Descriptor" on page 7-13.

7.2.4.1 Adding or Editing a QoS Flow Descriptor

When you click on the **Add...** or **Edit...** button on the QoS tab, the Legacy Application QoS window appears, as shown in Figure 7.6. Use this window to define:

- The traffic to which the QoS is applied, by indicating the source and destination IP addresses and port numbers.
- Under what circumstances the QoS is to be applied, by indicating the traffic thresholds at which the QoS is imposed.
- The QoS specification itself.

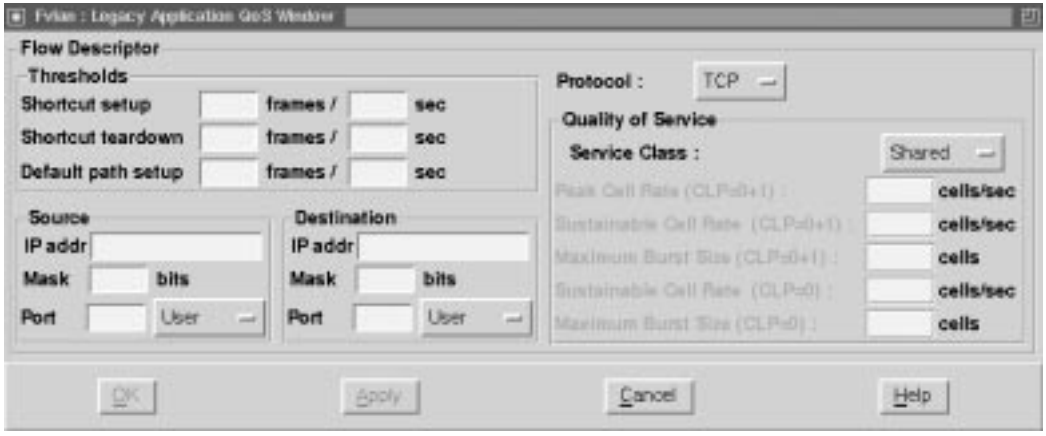


Figure 7.6 - Legacy Application QoS Window

The following are the flow descriptor parameters:

Shortcut setup — The traffic rate at which an MPOA shortcut will be created to replace the routed connection.

Shortcut teardown — The traffic rate on the short cut at which the short cut will be torn down and the default routed connection used.

Default path setup — The traffic rate at which a direct connection with a destination is established, rather than using the BUS.

Source IP addr — The source IP address of the traffic to which the QoS and shortcut thresholds will apply.

Source Mask	The number of bits in the source IP address that are significant.
Source Port	The source port of the traffic to which the QoS and shortcut thresholds will apply. Use the pull down list to select the port number of common applications.
Destination IP addr	The destination IP address of the traffic to which the QoS and shortcut thresholds will apply.
Destination Mask	The number of bits in the destination IP address that are significant.
Destination Port	The destination port of the traffic to which the QoS and shortcut thresholds will apply. Use pull down list to select the port number of common applications.
Protocol	The protocol to which the flow descriptor applies.
Service Class	The ATM QoS that will be applied to the connection. Possible QoS types are constant bit rate (CBR), variable bit rate (VBR), unknown bit rate (UBR), or shared (a UBR connection shared among all flows to the same destination).
Peak Cell Rate	The peak cell rate that will be allowed on the connection.
Sustainable Cell Rate	The sustained cell rate that will be allowed on the connection.
Maximum Burst Size	The maximum burst size that will be allowed on the connection.
Sustainable Cell Rate	The sustainable cell rate that will be allowed on the connection.
Maximum Burst Size (CLP=0)	The maximum burst size that will be allowed on the connection.

7.2.5 802-style VLAN Properties

Figure 7.7 shows an example of the VLAN802 tab. Parameters that are specific to the 802-style VLANs can be configured on a domain-wide basis or for specific 802-style VLANs.

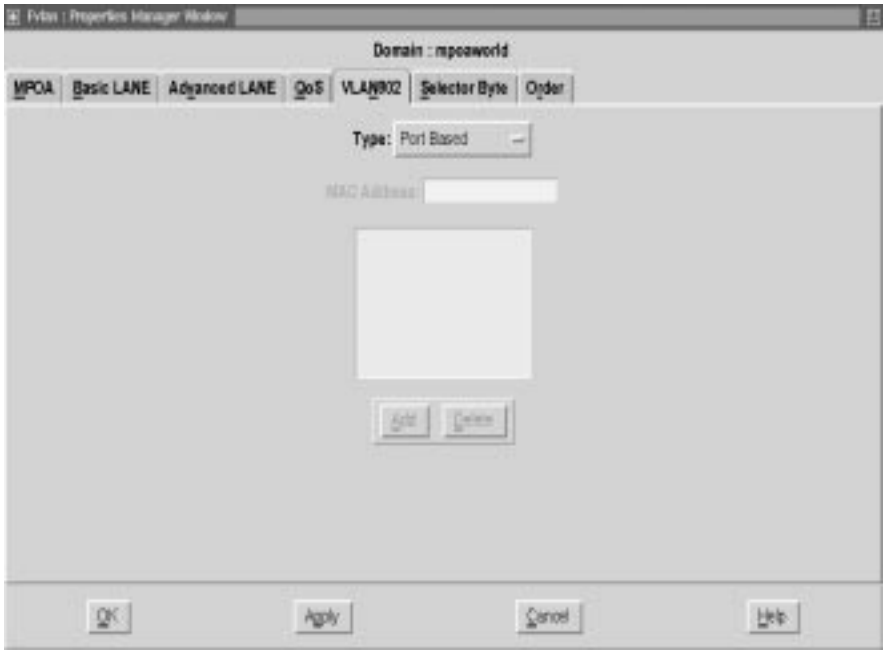


Figure 7.7 - 802-style VLAN Properties Tab

Provide the following information to specify an 802-style VLAN:

Type Select one of the following types:

- `Port Based` - Indicates that membership in the VLAN is determined by the ports on the ES-3810s that are members of the VLAN.
- `MAC Based` - Indicates that membership in the VLAN is determined by the MAC address of end hosts connected to ES-3810s that are members of the VLAN. Only ES-3810s can join MAC based VLANs.

- `PortMAC Based` - Indicates that membership in the VLAN is determined by both port and MAC address. Only ES-3810s can join PortMAC based VLANs.

MAC Address Enabled only when the VLAN type is MAC-Based or PortMAC-based. Specify a MAC address list for the VLAN. The listbox shows all the currently specified MAC addresses. To add a MAC address to the list, type in the MAC address into the entry box and click on the **`Add`** button. To delete a MAC address, select it in the listbox and press the **`Delete`** button.

7.2.6 Selector Byte

Figure 7.8 shows an example of the Selector Byte tab. This tab allows you to configure the selector byte for the LECS on a domain-wide basis, for the LES-BUS pair for specific ELANs, or for the LEC for specific members.

NOTE The selector byte for a LES and BUS that form a LES-BUS pair must be the same.

Figure 7.8 - Selector Byte Tab

The following columns are displayed in the tab:

Server Name The name of the server. In the case of changing selector byte for a client, the name of the field reads Client Name.

Type Type of server or client: LECS, DLE, or LEC.

NSAP The NSAP address. This field cannot be edited.

Selector Byte The selector byte to run the server with. This field can be configured.

Virtual Port (Virtual Segment) Indicates the virtual port or segment number that the client is using. This field appears only when editing the properties for a client.

7.2.6.1 Allowed Selector Byte Ranges

When you create a LEC, MPC or LES-BUS pair using VLAN Manager, VLAN Manager creates the server or client with an appropriate selector byte. In most cases you will never need to modify the selector byte of an item. If you do, Table 7.3 lists the allowed ranges for selector bytes on the various LANE-MPOA clients and servers. Note that you must make sure you do not take the same selector byte as another client or server running on the same device.

Table 7.3 - Allowed Selector Byte Ranges

Range	LEC	MPC	LES-BUS
0x00 to 0x1f	Allowed	Not Allowed	Not Allowed
0x20 to 0x7f	Not Allowed	Allowed	Not Allowed
0x80 to 0xfe	Not Allowed	Not Allowed	Allowed
0xff	Not Allowed	Not Allowed	Not Allowed

7.2.7 Order

Figure 7.9 shows an example of the Order tab. The Order tab allows you to edit the match-ordering list for the domain. The match-ordering list determines the order in which the LECS applies the accept-and-reject rules to members attempting to automatically join ELANs in the domain.

When a member attempts to join an ELAN automatically (i.e. it has been configured with Automatic ELAN Selection, and is not configured to join a specific ELAN), the member will attempt to join the first ELAN with which it is compatible (same ELAN type of Ethernet or Token-Ring and an MTU-size equal to or greater than that configured on the member) in the match-ordering list. If the accept-and-reject rules defined for that ELAN in the `LECS.CFG` file reject the member, it will attempt to join the next compatible ELAN in the list.

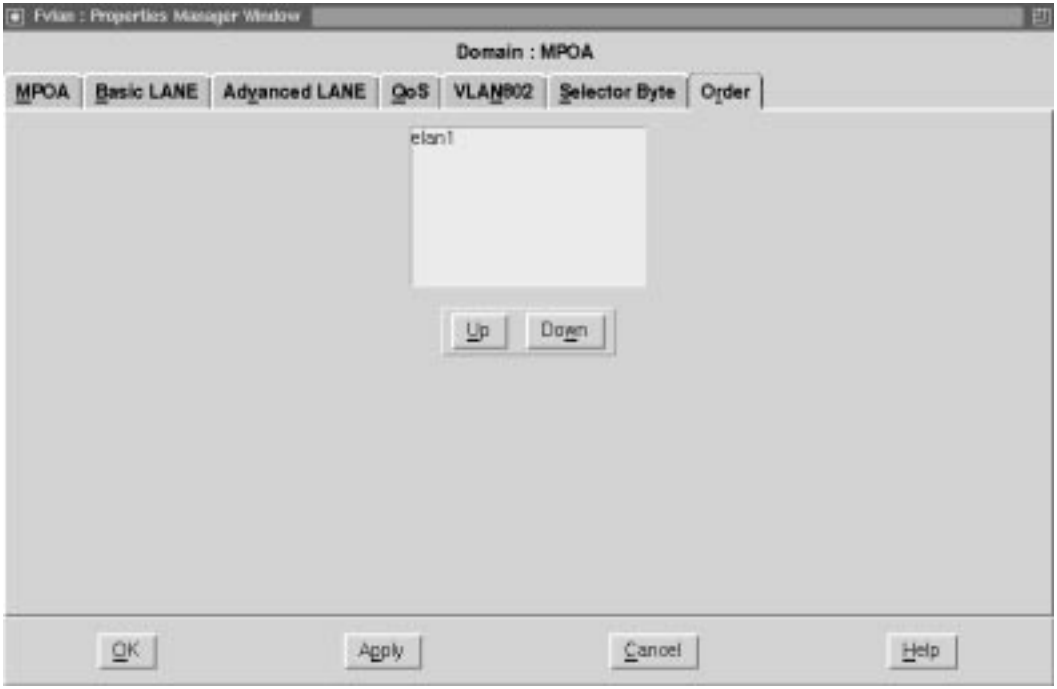


Figure 7.9 - Order Tab

To arrange an ELAN in the list, select the ELAN and use the Up and Down buttons to move it within the list.

7.3 Services Management

7.3.1 Using the GUI

The easiest and simplest way to add services on a machine is to drag the machine from the Available or Unassigned Members area at the bottom of the GUI into a CS, DLE, or MPS icon. When you subsequently perform a Commit function, the appropriate services will be started on that machine:

- If you dragged the machine into a CS icon, an LECS will be created and started on the machine.
- If you dragged the machine into a DLE icon, a LES-BUS pair will be created and started on the machine. By dragging additional machines into the DLE icon, you add additional peer services.

VLAN Manager will only allow you to drag-and-drop valid machine types into the services icons.

7.3.2 Using the Services Management Window

The Services Management window, shown in Figure 7.10, appears when you click the **Services...** button when creating or modifying a domain, VLAN, or member. It also appear when you double-click on a server icon.

The Services Management window includes a CS tab, in which you can configure LECS information for a domain, and an ELAN tab, in which you can configure LES-BUS and MPS information for a specific ELAN.

7.3.2.1 CS Tab

Figure 7.10 shows the Services Management Window with CS tab selected, providing management for Configuration Servers (CS).

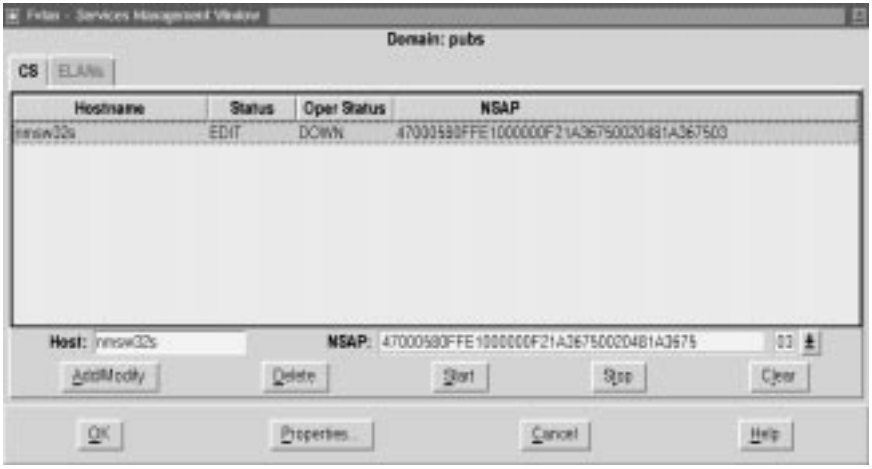


Figure 7.10 - Configuration Servers Management Window

This tab lists all configured LECS hostnames, their current status, and NSAP addresses. You can select more than one host in the list and then press the **`Start`**, **`Stop`**, or **`Delete`** button to start, stop, or delete the LECS on the selected hosts. If no line is selected, the three buttons are disabled.

You can use the **`Start`** and **`Stop`** buttons only when you choose the Manage LECS Services option of the Services menu. However, when you use the Commit function, VLAN Manager will automatically start and stop services as needed.

You can also select a single host and then change its selector byte.

This tab contains the following items.

Hostname Indicates the hostname of the server.

Status Indicates the modification status of the configuration server. If the server is newly added or has been modified, this field indicates Edit. Otherwise, this field is the same as Oper Status.

Oper Status Indicates the status of the configuration server, either Up, Down, Configured, or Unknown.

Host Indicates the hostname of the selected server.

NSAP Indicates the NSAP address of the selected server. The selector byte is displayed in a dropdown list and can be edited.

Add Button Adds additional hostnames entered or servers marked `Deleted` to the server list. The new hostnames show up in the top list with status unknown. If you do not specify an NSAP address for a new hostname, the VLAN Manager will try to retrieve the address from the hosts and display it in the listbox, if available. Support for LECS configuration will be checked for the newly added hosts. Hosts that do not support the LECS configuration prompt a warning message, and the host can not be added.

Delete Button Marks hosts as `Deleted`. If you select a deleted item, it can be added back. Servers with Up status can not be deleted. You must stop them first before the delete can take effect.

Start and Stop Buttons Start and stop the LECS service for the selected host-names.

Clear Button Clears the selection in the top listbox and also clears hostname and NSAP entries.

Properties Button Displays the Domain properties window with Selector Byte tab selected, where you can change the selector bit for existing LECS NSAP.

Update Button Re-reads the services from database.

If the service window is not launched from the menu bar, the **`Update`** button is replace by **`OK`** button. The **`Start`** and **`Stop`** buttons are disabled unless this window is invoked from the Services menu.

7.3.2.2 ELAN Server Management

The following figure shows the Services Management Window with ELANs and LES/BUS tabs selected. The ELANs tab includes the following components:

- A list of all available ELANs under the domain.
- Tabs for LES/BUS and MPS. These tabs display information for the selected ELAN in the list. Refer to "CS Tab" on page 7-21 for information on using the controls in these tabs.

7.3.2.2.1 LES/BUS Service Management

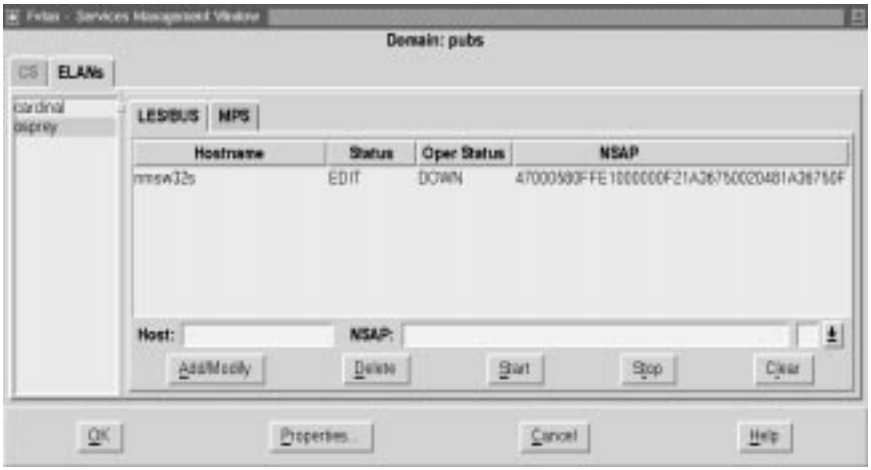


Figure 7.11 - LES/BUS Servers Management Window

To add additional LES-BUS pairs to the list, the new host and existing host must both support DLE. The VLAN Manager stops the LES/BUS servers on both hosts and restarts them with their new peer information.

The **`Properties`** button displays the VLAN Properties Manager window with Selector Byte tab selected. You can then change the selector byte for the LES/BUS NSAP.

NOTE The MPS tab is not supported in this release of VLAN Manager.

APPENDIX A Modifying a FV 4.x LECS Configuration File

The VLAN Manager and the LECS use a text configuration file that contains the configuration information needed by member LECs that wish to participate in an ELAN. The LECS configuration file may be built and edited using a text editor such as `vi` or `emacs`.

The LECS configuration file used with previous releases of the VLAN Manager (versions 4.0.x, 4.1.x) needs to be reconciled with the LECS configuration file used with version 4.3.x of the VLAN Manager. The following message appears when trying to retrieve the LECS database:

> The file on <lecs-host-name> is an older version. It needs to be converted to the current version. Refer to the user manual for information on converting the file to new format

Versions 4.0.x and 4.1.x of the VLAN Manager supported the emulation of Ethernet (IEEE 802.3) LANs only. In this emulated LAN environment, a member (LEC) provides a MAC level emulated Ethernet interface which appears to higher level software as though a physical Ethernet interface is present. Each LEC registers with both the LES and BUS associated with the ELAN it wishes to join before participating in the ELAN.

The operation of an ELAN and its components from the point of view of a LEC may be divided into three phases:

1. Initialization
2. Registration and Address Resolution
3. Data Transfer

In versions 4.0.x and 4.1.x of the VLAN Manager, client membership to an ELAN was based on the MAC address information. In version 4.3.x of the VLAN Manager, client membership is now based on the NSAP address information. To use an LECS configuration file that was created with either version 4.0.x or 4.1.x of the VLAN Manager, the MAC addresses of all LECs (members or clients) must be converted to their corresponding NSAP address in the configuration file maintained by the network administrator.

A.1 Before You Begin

Before modifying the LECS configuration file to a file that is compatible with version 4.3.x of the VLAN Manager, you should first document the topology of the ELAN or ELANs that have been configured. The following information already is available in the current LECS file, which can be saved as a local text file and printed:

- The name of each ELAN (`engineering`, `marketing`, etc.).
- The NSAP address of the LES and BUS for each ELAN.
- If you wish LECs to use a default ELAN, the default LES information must also be included.

You must add the following information when editing the LECS configuration file:

- The NSAP address and correct selector bytes of each LEC that may participate in each ELAN.

CAUTION

Do not attempt to edit an existing functional LECS configuration file. First make a backup copy of the file and use that file for editing. Incorrect modification of the configuration file could result in loss of communication between one or more members of a defined ELAN. It may also result in one or more of the ELAN(s) defined in the file going "down".

A.1.1 Obtaining NSAP Addresses

Because the membership of a client in version 4.3 of the VLAN Manager is now based on the NSAP address information, the following example shows how to retrieve NSAP information for a UNIX machine named montain using the **`elconfig show -configured`** command.

You must be logged in as a superuser to use the **`elconfig show -configured`** command.

This command will display the configured ELAN information as well as the NSAP addresses for the LEC, LES, BUS, and LECS.

```
montain-red-etc=> su
Password:
# ./elconfig show -configured
ELAN(s) on Adapter 0
-----------------------
ELAN          NI       ATM Addresses
----          --       -------------
red           el0      LEC:  0x47.0005.80.ffe100.0000.f20f.01fc.002048060064.00
                       LES:  0x47.0005.80.ffe100.0000.f20f.01fc.0000ef0432e0.50
                             direct vpi.vci=0.33  distribute vpi.vci=0.34
                       BUS:  0x47.0005.80.ffe100.0000.f20f.01fc.0000ef0432e0.51
                             send vpi.vci=0.35  forward vpi.vci=0.36
                       LECS: 0x47.0079.00.000000.0000.0000.0000.00a03e000001.00
                       LAN-Type:           Ethernet/IEEE 802.3
                       Maximum-Frame-Size: 1516
                       State:              operational
                       LECID:              615
                       Actual ELAN Name:   red
```

The LEC NSAP address format that is required for the conversion would be 47000580ffe1000000f20f01fc002048060064 00, thus dropping the `0x` at the beginning and the decimals.

A.1.2 Retrieving a Configuration File

NOTE

Use a previous version of the VLAN Manager (4.1.x or earlier) to retrieve and save the LECS configuration file.

To retrieve the LECS configuration file, pull down the **`File`** menu and select the **`Retrieve config from LECS...`** option. Enter the machine name where the LECS configuration is stored in the dialog (Figure A.1).

Figure A.1 - Retrieve LECS dialog

NOTE

On Windows NT, if a shortcut previously was used to open the LECS configuration file, the shortcut will not work with the new version.

A.1.3 Creating a Local Backup File

To create a local backup of the LECS configuration file, pull down the **`File`** menu and select the **`Local Backup/Save as...`** option. Enter the file name in the dialog similar to Figure A.2.

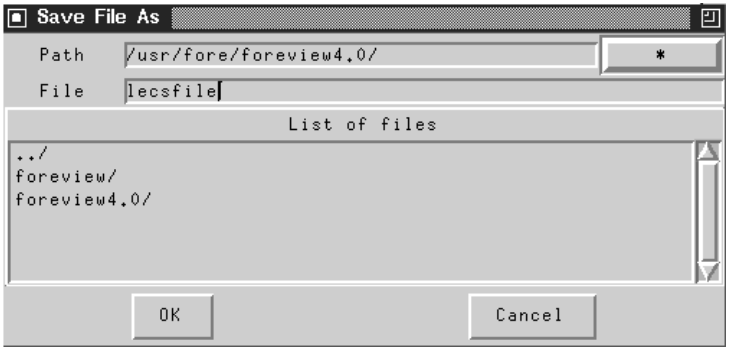


Figure A.2 - Save Local LECS dialog

A.1.4 Editing the LECS Configuration File

Using a text editor such as **`vi`** or **`emacs`**, edit the LECS configuration file. The following modifications are required:

- Convert all LEC MAC addresses to NSAP addresses.
- Remove the .Accept statement from the beginning of the file.
- Associate the LECs with the correct ELANs.
- Save the file.

The following is a sample configuration file. For a more detailed explanation of the syntax used in the LECS file, refer to the AMI Configuration User's Manual that came with your FORE Systems ATM switch.

```
#
# The search ordering of elan names
#
Match.Ordering:default, Red, Green
#
# Parameters for the active default vlan
#
default.Address:
47000580ffe1000000f2150e95002048150e9501
default.BUS_Address:47000580ffe1000000f2150e95002048150e9501
default.Machine_Name:  owl
default.BUS_Machine_Name:  owl
default.Accept: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

#
# Parameters for elan: DEFAULT
#
.Accept: 002048060064, \
         0020481006a1
.Multicast_Send_VCC_Type: Best Effort
.Maximum_Unknown_Frame_Time: 1
.LAN_Type: Ethernet/IEEE 802.3
.Maximum_Unknown_Frame_Count: 1
.VCC_TimeOut_Period: 1200
.Forward_Delay_Time: 15
.Maximum_Frame_Size: 1516
.Expected_LE_ARP_Response_Time: 1
.Path_Switching_Delay: 6
.Aging_Time: 300
.Control_TimeOut: 120
```

The "default" ELAN parameters should be complete with these 5 statements. If not, delete the "default" entries entirely.

Delete this .Accept statement only

```
.Flush_TimeOut: 4
.Connection_Complete_Timer: 4
.Maximum_Retry_Count: 1

#
# Parameters for elan: Red
#
Red.Accept: 002048060064, \
            0020481006a1
Red.Accept: 47000580ffe1000000f20f01fc002048060064XX,\
            47000580ffe1000000f20f01fc0020481006a1XX

Red.BUS_Address: 47000580ffe1000000f21a1e6d0020481a1e6d01
Red.Machine_Name: rabbit
Red.LAN_Name: Red
Red.Address: 47000580ffe1000000f21a1e6d0020481a1e6d01
Red.BUS_Machine_Name: rabbit

#
# Parameters for elan: Green
#
Green.Accept: 0020481006a1
Green.Accept: 47000580ffe1000000f20f01fc0020481006a1ff

Green.BUS_Address: 47000580ffe1000000f21a1e6d0020481a1e6d02
Green.Machine_Name: rabbit
Green.LAN_Name: Green
Green.Address: 47000580ffe1000000f21a1e6d0020481a1e6d02
Green.BUS_Machine_Name: rabbit

#
# Parameters for client: 002048060064
# Parameters for client: 47000580ffe1000000f20f01fc00204806006400

#
002048060064.Machine_Name: montain-red
47000580ffe1000000f20f01fc00204806006400.Machine_Name:montain-red
47000580ffe1000000f20f01fc00204806006400.LAN_Name: Red

#
```

Convert these MAC Addresses.

...to the correct NSAP Addresses. In the .Accept statements, use wildcards for the selector bytes.

Convert this MAC Address...

...to the correct NSAP Address & selector byte.

Convert this MAC Address...

...to the correct NSAP Address.

Replace the MAC Address here...

...with the NSAP Address & the correct selector byte. Thenadd the associated LAN name for the LEC right below.

```
# Parameters for client: 0020481006a1
# Parameters for client: 47000580ffe1000000f20f01fc0020481006a100

#
0020481006a1.Machine_Name: diablo

47000580ffe1000000f20f01fc0020481006a100.Machine_Name: diablo
47000580ffe1000000f20f01fc0020481006a100.LAN_Name: Red

#

# Parameters for client: 47000580ffe1000000f20f01fc0020481006a1ff
#
47000580ffe1000000f20f01fc0020481006a1ff.Machine_Name: diablo
47000580ffe1000000f20f01fc0020481006a1ff.LAN_Name: Green

#
# entries that the VLAN Manager does not parse at this time
#
LECS.Reload_Period: 30
```

Convert this MAC Address here...

...to the correct NSAP Address.

Replace the MAC Address here...

...with the NSAP Address, then add the associated LAN name for the LEC right below.

Because Diablo belongs to two ELANs, a second entry is required. Note the different selector byte (ff).

A.1.4.1 New Configuration File Sample

The following is a sample of a new configuration file that is compatible with version 4.3 of the VLAN Manager.

```
#
# The search ordering of elan names
#
Match.Ordering:default, Red, Green
#
# Parameters for the active default vlan
#
default.Address:47000580ffe1000000f2150e95002048150e9501
default.BUS_Address:47000580ffe1000000f2150e95002048150e9501
default.Machine_Name:  owl
default.BUS_Machine_Name:  owl
default.Accept: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

#
# Parameters for elan: DEFAULT
```

```
#


.Multicast_Send_VCC_Type: Best Effort
.Maximum_Unknown_Frame_Time: 1
.LAN_Type: Ethernet/IEEE 802.3
.Maximum_Unknown_Frame_Count: 1
.VCC_TimeOut_Period: 1200
.Forward_Delay_Time: 15
.Maximum_Frame_Size: 1516
.Expected_LE_ARP_Response_Time: 1
.Path_Switching_Delay: 6
.Aging_Time: 300
.Control_TimeOut: 120
.Flush_TimeOut: 4
.Connection_Complete_Timer: 4
.Maximum_Retry_Count: 1

#
# Parameters for elan: Red
#
Red.Accept: 47000580ffe1000000f20f01fc00204806006400, \
            47000580ffe1000000f20f01fc0020481006a100
Red.BUS_Address: 47000580ffe1000000f21a1e6d0020481a1e6d01
Red.Machine_Name: rabbit
Red.LAN_Name: Red
Red.Address: 47000580ffe1000000f21a1e6d0020481a1e6d01
Red.BUS_Machine_Name: rabbit

#
# Parameters for elan: Green
#
Green.Accept: 47000580ffe1000000f20f01fc0020481006a1ff
Green.BUS_Address: 47000580ffe1000000f21a1e6d0020481a1e6d02
Green.Machine_Name: rabbit
Green.LAN_Name: Green
Green.Address: 47000580ffe1000000f21a1e6d0020481a1e6d02
Green.BUS_Machine_Name: rabbit

#
# Parameters for client: 47000580ffe1000000f20f01fc00204806006400
#
47000580ffe1000000f20f01fc00204806006400.Machine_Name: montain-red
```

```
47000580ffe1000000f20f01fc00204806006400.LAN_Name: Red
#
# Parameters for client: 47000580ffe1000000f20f01fc0020481006a100
#
47000580ffe1000000f20f01fc0020481006a100.Machine_Name: diablo
47000580ffe1000000f20f01fc0020481006a100.LAN_Name: Red

#
# Parameters for client: 47000580ffe1000000f20f01fc0020481006a1ff
#
47000580ffe1000000f20f01fc0020481006a1ff.Machine_Name: diablo
47000580ffe1000000f20f01fc0020481006a1ff.LAN_Name: Green

#
# entries that the VLAN Manager does not parse at this time
#
LECS.Reload_Period: 30
```

A.1.5 Reading the New Configuration File

Once the edited LECS configuration file is saved, you can open the file in the 4.3 VLAN Manager, as illustrated in Figure A.3

Figure A.3 - Open Local File Dialog

A.1.6 Using the New Configuration File

As shown in Figure A.4, the VLAN Manager's main interface window in version 4.3 is divided into three sections. The top section identifies the managed domains, the center section identifies the managed VLANs and their related members, and the bottom section identifies the managed machines.

The "drag and drop" operations used to assign members to a particular ELAN, 802-style VLAN, or Hybrid VLAN cannot be used on machines in the **`Unassigned Members:`** or the **`Available Members:`** sections until the machines are modified to retrieve the correct NSAP addresses and selector bytes. For more information, see the sections on modifying members found in "Configuring VLANs and Members" on page 6-1.

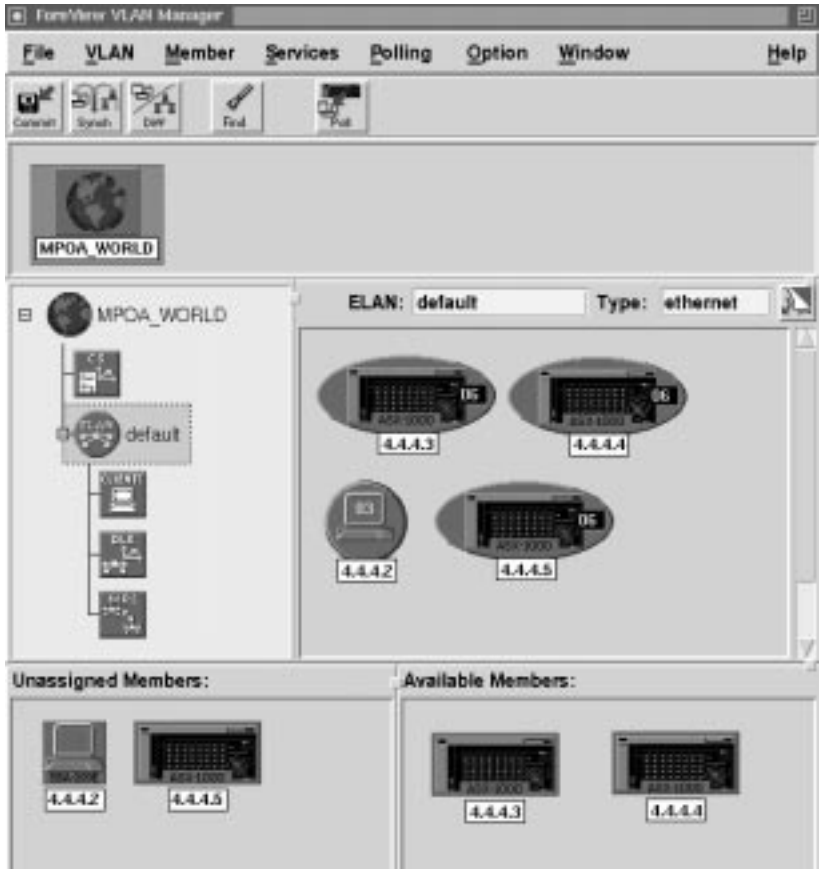


Figure A.4 - VLAN Manager Main Window

NOTE

Once you are comfortable with the new VLAN configuration, you can specify a configuration server to where the new LECS can be saved (for example, the machine eagle as shown in Figure A.1). When the changes are committed, the old LECS file is replaced with the new LECS file.

Acronyms

The networking terms in the following list are defined in the Glossary of this manual. Glossary items are listed alphabetically according to the full term.

AAL	ATM Adaptation Layer
ABR	Available Bit Rate
ACM	Address Complete Message
ACR	Allowable Cell Rate
ADPCM	Adaptive Differential Pulse Code Modulation
AHFG	ATM-attached Host Functional Group
AIMUX	ATM Inverse Multiplexing
AIS	Alarm Indication Signal
AMI	Alternate Mark Inversion
AMI	ATM Management Interface
ANSI	American National Standards Institute
APCM	Adaptive Pulse Code Modulation
API	Application Program Interface
APP	Application Program
APS	Automatic Protection Switching
ARP	Address Resolution Protocol
ASCII	American Standard Code for Information Interchange
ATDM	Asynchronous Time Division Multiplexing
ATM	Asynchronous Transfer Mode
AUI	Attachment User Interface
B8ZS	Bipolar 8 Zero Substitution
BCOB	Broadband Connection Oriented Bearer
BCOB-A	Bearer Class A
BCOB-C	Bearer Class C
BCOB-X	Bearer Class X
BECN	Backward Explicit Congestion Notification
BER	Bit Error Rate
BES	Bursty Errored Seconds
BGP	Border Gateway Protocol
B-ICI	B-ISDN Inter-Carrier Interface.
BIP	Bit Interleaved Parity
B-ISDN	Broadband Integrated Services Digital Network
B-ISUP	Broadband ISDN User's Part

BITS	Building Integrated Timing Supply
BNC	Bayonet-Neill-Concelman
BPDU	Bridge Protocol Data Unit
bps	Bits per Second
BPV	Bipolar Violation
B-TE	Broadband Terminal Equipment
BUS	Broadcast and Unknown Server
CAC	Connection Admission Control
CAS	Channel Associated Signaling
CBDS	Connectionless Broadband Data Service
CBR	Constant Bit Rate
CCITT	International Telephone and Telegraph Consultative Committee
CCS	Common Channel Signaling
CDV	Cell Delay Variation
CE	Connection Endpoint
CEI	Connection Endpoint Identifier
CES	Circuit Emulation Service
CGA	Carrier Group Alarm
CIP	Carrier Identification Parameter
CIR	Committed Information Rate
CLIP	Classical IP
CLP	Cell Loss Priority
CLR	Cell Loss Ratio-1-15
CLS	Connectionless service
CMIP	Common Management Interface Protocol
CMR	Cell Misinsertion Rate
CPE	Customer Premise Equipment
CRA	Cell Rate Adaptation
CRC	Cyclic Redundancy Check
CRS	Cell Relay Service
CS	Controlled Slip, **or** Convergence Sublayer
CSU	Channel Service Unit
CTD	Cell Transfer Delay
CTS	Clear To Send
DACS	Digital Access and Cross-Connect System
DARPA	Defense Advanced Research Projects Agency
DCC	Data Country Code
DCE	Data Communications Equipment
DCS	Digital Cross-connect System
DES	Destination End Station
DFA	DXI Frame Address
DLCI	Data Link Connection Identifier

DNS	Domain Naming System
DSn	Digital Standard n (n=0, 1, 1C, 2, and 3)
DSR	Data Set Ready
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EEPROM	Electrically Erasable Programmable Read Only Memory
EFCI	Explicit Forward Congestion Indication
EGP	Exterior Gateway Protocol
EIA	Electronics Industries Association
EISA	Extended Industry Standard Architecture
ELAN	Emulated Local Area Network
EMI	Electromagnetic Interference
EPROM	Erasable Programmable Read Only Memory
EQL	Equalization
ER	Explicit Rate
ES	End System, **or** Errored Second
ESF	Extended Super Frame
ESI	End System Identifier
EXZ	Excessive Zeroes (Error Event)
FC	Face Contact
FCC	Federal Communications Commission
FCS	Frame Check Sequence
FDDI	Fiber Distributed Data Interface
FDM	Frequency Division Multiplexing
FEBE	Far End Block Error
FEC	Forward Error Correction
FECN	Forward Explicit Congestion Notification
FERF	Far End Receive Failure
FIFO	First-In, First-Out
FRS	Frame-Relay Service
FTP	File Transfer Protocol
FT-PNNI	ForeThought PNNI
FUNI	Frame-Based UNI
GCAC	Generic Connection Admission Control
GCRA	Generic Cell Rate Algorithm
GFC	Generic Flow Control
HDB3	High Density Bipolar
HDLC	High Level Data Link Control
HEC	Header Error Control
HIPPI	High Performance Parallel Interface
HSSI	High-Speed Serial Interface
ICMP	Internet Control Message Protocol

IDU	Interface Data Unit
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
ILMI	Interim Local Management Interface
IP	Internet Protocol
IPX	Internetwork Packet Exchange
IS	Intermediate system
ISDN	Integrated Services Digital Network
ISO	International Standards Organization
ITU-T	International Telecommunication Union Telecommunication
IWF	Interworking Function
IXC	Interexchange Carriers
JPEG	Joint Photographic Experts Group
Kbps	Kilobits per second
LAN	Local Area Network
LANE	LAN Emulation
LAPB	Link Access Procedure, Balanced
LATA	Local Access and Transport Area
LBO	Line Build Out
LCV	Line Code Violations
LE_ARP	LAN Emulation Address Resolution Protocol
LEC	LAN Emulation Client
LECS	LAN Emulation Configuration Server
LES	LAN Emulation Server
LLC	Logical Link Control
LOF	Loss Of Frame
LOP	Loss Of Pointer
LOS	Loss Of Signal
LSB	Least Significant Bit
MAC	Media Access Control
MAN	Metropolitan Area Network
MAU	Media Attachment Unit
MBS	Maximum Burst Size
MCDV	Maximum Cell Delay Variance
MCLR	Maximum Cell Loss Ratio
MCR	Minimum Cell Rate
MCTD	Maximum Cell Transfer Delay
MIB	Management Information Base
MIC	Media Interface Connector
MID	Message Identifier
MMF	Multimode Fiber Optic Cable
MPC	Multiprotocol Client
MPEG	Motion Picture Experts Group

MPOA	Multiprotocol over ATM
MPS	Multiprotocol Server
MSB	Most Significant Bit
MTU	Maximum Transmission Unit
NM	Network Management Entity
NML	Network Management Layer
NMS	Network Management Station
NNI	Network-to-Network Interface or Network Node Interface
NPC	Network Parameter Control
NRZ	Non Return to Zero
NRZI	Non Return to Zero Inverted
NSAP	Network Service Access Point
NTSC	National TV Standards Committee
OAM	Operation and Maintenance Cell
OC-n	Optical Carrier level-n
OID	Object Identifier
OOF	Out-of-Frame
OSI	Open Systems Interconnection
OSPF	Open Shortest Path First Protocol
OUI	Organizationally Unique Identifier
PAD	Packet Assembler Disassembler
PAL	Phase Alternate Line
PBX	Private Branch Exchange
PCI	Peripheral Component Interconnect
PCM	Pulse Code Modulation
PCR	Peak Cell Rate
PDN	Public Data Network
PDU	Protocol Data Unit
PHY	Physical Layer
ping	Packet Internet Groper
PLCP	Physical Layer Convergence Protocol
PLP	Packet Level Protocol
PM	Physical Medium
PMD	Physical Medium Dependent
PNNI	Private Network Node Interface or Private Network-to-Network Interface
PPP	Point-to-Point Protocol
PROM	Programmable Read-Only Memory
PRS	Primary Reference Source
PSN	Packet Switched Network
PT	Payload Type
PVC	Permanent Virtual Circuit (or Channel)
PVCC	Permanent Virtual Channel Connection
PVPC	Permanent Virtual Path Connection

QD	Queuing Delay
QoS	Quality of Service
RD	Routing Domain
RFCs	Requests For Comment
RFI	Radio Frequency Interference
RIP	Routing Information Protocol
RISC	Reduced Instruction Set Computer
RTS	Request To Send
SA	Source Address
SA	Source MAC Address
SAP	Service Access Point
SAR	Segmentation And Reassembly
SC	Structured Cabling, **or** Structured Connectors, **or** Stick and Click
SCR	Sustainable Cell Rate
SCSI	Small Computer Systems Interface
SDLC	Synchronous Data Link Control
SDU	Service Data Unit
SEAL	Simple and Efficient Adaptation Layer
SECAM	Systeme En Coleur Avec Memoire
SEL	Selector
SES	Severely Errored Seconds
SF	Super Frame
SGMP	Simple Gateway Management Protocol
SIR	Sustained Information Rate
SLIP	Serial Line IP
SMDS	Switched Multimegabit Data Service
SMF	Single Mode Fiber
SMTP	Simple Mail Transfer Protocol
SNA	Systems Network Architecture
SNAP	SubNetwork Access Protocol
SNI	Subscriber Network Interface
SNMP	Simple Network Management Protocol
SONET	Synchronous Optical Network
SPANS	Simple Protocol for ATM Network Signalling
SPARC	Scalable Processor Architecture Reduced instruction set Computer
SPE	Synchronous Payload Envelope
SPVC	Smart PVC
SS7	Signaling System No. 7
SSCOP	Service Specific Connection Oriented Protocol
SSCS	Service Specific Convergence Sublayer
ST	Straight Tip, **or**

	Stick and Turn
STM	Synchronous Transfer Mode
STP	Shielded Twisted Pair, Spanning Tree Protocol
STS	Synchronous Transport Signal
SVC	Switched Virtual Circuit (or Channel)
SVCC	Switched Virtual Channel Connection
SVPC	Switched Virtual Path Connection
TAXI	Transparent Asynchronous Transmitter / Receiver Interface
TC	Transmission Convergence
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol / Internet Protocol
TCR	Tagged Cell Rate
TCS	Transmission Convergence Sublayer
TDM	Time Division Multiplexing
TE	Terminal Equipment
TFTP	Trivial File Transfer Protocol
TM	Traffic Management
UAS	Unavailable Seconds
UBR	Unspecified Bit Rate
UDP	User Datagram Protocol
UNI	User-to-Network Interface
UPC	Usage Parameter Control
UTOPIA	Universal Test & Operations Interface for ATM
UTP	Unshielded Twisted Pair
VBR	Variable Bit Rate
VC	Virtual Channel (or Circuit)
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VCL	Virtual Channel Link
VINES	Virtual Network Software
VLAN	Virtual Local Area Network
VP	Virtual Path
VPC	Virtual Path Connection
VPDN	Virtual Private Data Network
VPI	Virtual Path Identifier
VPL	Virtual Path Link
VPN	Virtual Private Network
VPT	Virtual Path Terminator
VS/VD	Virtual Source / Virtual Destination
VT	Virtual Tributary
WAN	Wide-Area Network
ZBTSI	Zero Byte Time Slot Interchange

Glossary

10Base-T - a 10 Mbps baseband Ethernet specification utilizing twisted-pair cabling (Category 3, 4, or 5). 10BaseT, which is part of the IEEE 802.3 specification, has a distance limit of approximately 100 meters per segment.

802.1d Spanning Tree Bridging - the IEEE standard for bridging; a MAC layer standard for transparently connecting two or more LANs (often called subnetworks) that are running the same protocols and cabling. This arrangement creates an extended network, in which any two workstations on the linked LANs can share data.

802.3 Ethernet - the IEEE standard for Ethernet; a physical-layer standard that uses the CSMA/CD access method on a bus-topology LAN.

802.5 Token Ring - the IEEE physical-layer standard that uses the token-passing access method on a ring-topology LAN.

AAL Connection - an association established by the AAL between two or more next higher layer entities.

Adapter - A fitting that supplies a passage between two sets of equipment when they cannot be directly interconnected.

Adaptive Differential Pulse Code Modulation (ADPCM) - A technique that allows analog voice signals to be carried on a 32K bps digital channel. Sampling is done at 8Hz with 4 bits used to describe the difference between adjacent samples.

Adaptive Pulse Code Modulation (APCM) - A technique that effectively reduces occupied bandwidth per active speaker by reducing sampling rates during periods of overflow peak traffic.

Address - A unique identity of each network station on a LAN or WAN.

Address Complete Message (ACM) - A B-ISUP call control message from the receiving exchange to sending exchange indicating the completion of address information.

Address Mask - a bit mask used to identify which bits in an address (usually an IP address) are network significant, subnet significant, and host significant portions of the complete address. This mask is also known as the subnet mask because the subnetwork portion of the address can be determined by comparing the binary version of the mask to an IP address in that subnet. The mask holds the same number of bits as the protocol address it references.

Address Prefix - A string of 0 or more bits up to a maximum of 152 bits that is the lead portion of one or more ATM addresses.

Address Resolution - The procedure by which a client associates a LAN destination with the ATM address of another client or the BUS.

Address Resolution Protocol (ARP) - a method used to resolve higher level protocol addressing (such as IP) into the appropriate header data required for ATM; i.e., port, VPI, and VCI; also defines the AAL type to be used.

Agent - a component of network- and desktop-management software, such as SNMP, that gathers information from MIBs.

alarm - an unsolicited message from a device, typically indicating a problem with the system that requires attention.

Alarm Indication Signal (AIS) - In T1, an all ones condition used to alert a receiver that its incoming signal (or frame) has been lost. The loss of signal or frame is detected at the receiving end, and the failed signal is replaced by all the ones condition which the receiver interprets as an AIS. The normal response to this is AIS is for the receiving end to generate a yellow alarm signal as part of its transmission towards the faulty end. (The AIS itself is sometimes called a Blue Signal).

A-Law - The PCM coding and companding standard used in Europe.

Allowable Cell Rate (ACR) - parameter defined by the ATM Forum for ATM traffic management. ACR varies between the MCR and the PCR, and is dynamically controlled using congestion control mechanisms.

Alternate Mark Inversion (AMI) - A line coding format used on T1 facilities that transmits ones by alternate positive and negative pulses.

Alternate Routing - A mechanism that supports the use of a new path after an attempt to set up a connection along a previously selected path fails.

American National Standards Institute (ANSI) - a private organization that coordinates the setting and approval of some U.S. standards. It also represents the United States to the International Standards Organization.

American Standard Code for Information Interchange (ASCII) - a standard character set that (typically) assigns a 7-bit sequence to each letter, number, and selected control characters.

AppleTalk - a networking protocol developed by Apple Computer for communication between Apple's products and other computers. Independent of the network layer, AppleTalk runs on LocalTalk, EtherTalk and TokenTalk.

Application Layer - Layer seven of the ISO reference model; provides the end-user interface.

Application Program (APP) - a complete, self-contained program that performs a specific function directly for the user.

Application Program Interface (API) - a language format that defines how a program can be made to interact with another program, service, or other software; it allows users to develop custom interfaces with FORE products.

Assigned Cell - a cell that provides a service to an upper layer entity or ATM Layer Management entity (ATMM-entity).

asxmon - a FORE program that repeatedly displays the state of the switch and its active ports.

Asynchronous Time Division Multiplexing (ATDM) - a multiplexing technique in which a transmission capability is organized into a priori, unassigned time slots. The time slots are assigned to cells upon request of each application's instantaneous real need.

Asynchronous Transfer Mode (ATM) - a transfer mode in which the information is organized into cells. It is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic.

ATM Adaptation Layer (AAL) - the AAL divides user information into segments suitable for packaging into a series of ATM cells. AAL layer types are used as follows:

AAL-1 - constant bit rate, time-dependent traffic such as voice and video
AAL-2 - still undefined; a placeholder for variable bit rate video transmission
AAL-3/4 - variable bit rate, delay-tolerant data traffic requiring some sequencing and/or error detection support (originally two AAL types, connection-oriented and connectionless, which have been combined)
AAL-5 - variable bit rate, delay-tolerant, connection-oriented data traffic requiring minimal sequencing or error detection support

ATM Address - Defined in the UNI Specification as 3 formats, each having 20 bytes in length.

ATM Forum - an international non-profit organization formed with the objective of accelerating the use of ATM products and services through a rapid convergence of interoperability specifications. In addition, the Forum promotes industry cooperation and awareness.

ATM Inverse Multiplexing (AIMUX) - A device that allows multiple T1 or E1 communications facilities to be combined into a single broadband facility for the transmission of ATM cells.

ATM Layer link - a section of an ATM Layer connection between two adjacent active ATM Layer entities (ATM-entities).

ATM Link - a virtual path link (VPL) or a virtual channel link (VCL).

ATM Management Interface (AMI) - the user interface to FORE Systems' *ForeThought* switch control software (SCS). AMI lets users monitor and change various operating configurations of FORE Systems switches and network module hardware and software, IP connectivity, and SNMP network management.

ATM Peer-to-Peer Connection - a virtual channel connection (VCC) or a virtual path connection (VPC) directly established, such as workstation-to-workstation. This setup is not commonly used in networks.

ATM Traffic Descriptor - a generic list of parameters that can be used to capture the intrinsic traffic characteristics of a requested ATM connection.

ATM User-to-User Connection - an association established by the ATM Layer to support communication between two or more ATM service users (i.e., between two or more next higher layer entities or between two or more ATM entities). The communication over an ATM Layer connection may be either bidirectional or unidirectional. The same Virtual Channel Identifier (VCI) is used for both directions of a connection at an interface.

atmarp - a FORE program that shows and manipulates ATM ARP entries maintained by the given device driver. This is also used to establish PVC connections.

ATM-attached Host Functional Group (AHFG) - The group of functions performed by an ATM-attached host that is participating in the MPOA service.

atmconfig - a FORE program used to enable or disable SPANS signaling.

atmstat - a FORE program that shows statistics gathered about a given adapter card by the device driver. These statistics include ATM layer and ATM adaptation layer cell and error counts. This can also be used to query other hosts via SNMP.

Attachment User Interface (AUI) - IEEE 802.3 interface between a media attachment unit (MAU) and a network interface card (NIC). The term AUI can also refer to the rear panel port to which an AUI cable might attach.

Auto-logout - a feature that automatically logs out a user if there has been no user interface activity for a specified length of time.

Automatic Protection Switching (APS) - Equipment installed in communications systems to detect circuit failures and automatically switch to redundant, standby equipment.

Available Bit Rate (ABR) - a type of traffic for which the ATM network attempts to meet that traffic's bandwidth requirements. It does not guarantee a specific amount of bandwidth and the end station must retransmit any information that did not reach the far end.

Backbone - the main connectivity device of a distributed system. All systems that have connectivity to the backbone connect to each other, but systems can set up private arrangements with each other to bypass the backbone to improve cost, performance, or security.

Backplane - High-speed communications line to which individual components are connected.

Backward Explicit Congestion Notification (BECN) - A Resource Management cell type generated by the network or the destination, indicating congestion or approaching congestion for traffic flowing in the direction opposite that of the BECN cell.

Bandwidth - usually identifies the capacity or amount of data that can be sent through a given circuit; may be user-specified in a PVC.

Baud - unit of signalling speed, equal to the number of discrete conditions or signal events per second. If each signal event represents only one bit, the baud rate is the same as bps; if each signal event represents more than one bit (such as a dibit), the baud rate is smaller than bps.

Bayonet-Neill-Concelman (BNC) - a bayonet-locking connector used to terminate coaxial cables. BNC is also referred to as Bayonet Network Connector.

Bipolar 8 Zero Substitution (B8ZS) - a technique used to satisfy the ones density requirements of digital T-carrier facilities in the public network while allowing 64 Kbps clear channel data. Strings of eight consecutive zeroes are replaced by an eight-bit code representing two intentional bipolar pulse code violations (000V10V1).

Bipolar Violation (BPV) - an error event on a line in which the normal pattern of alternating high (one) and low (zero) signals is disrupted. A bipolar violation is noted when two high signals occur without an intervening low signal, or vice versa.

B-ISDN Inter-Carrier Interface (B-ICI) - An ATM Forum defined specification for the interface between public ATM networks to support user services across multiple public carriers.

Bit Error Rate (BER) - A measure of transmission quality, generally shown as a negative exponent, (e.g., 10^{-7} which means 1 out of 10^{7} bits [1 out of 10,000,000 bits] are in error).

Bit Interleaved Parity (BIP) - an error-detection technique in which character bit patterns are forced into parity, so that the total number of one bits is always odd or always even. This is accomplished by the addition of a one or zero bit to each byte, as the byte is transmitted; at the other end of the transmission, the receiving device verifies the parity (odd or even) and the accuracy of the transmission.

Bit Robbing - The use of the least significant bit per channel in every sixth frame for signaling.

Bit Stuffing - A process in bit-oriented protocols where a zero is inserted into a string of ones by the sender to prevent the receiver from interpreting valid user data (the string of ones) as control characters (a Flag character for instance).

Border Gateway Protocol (BGP) - used by gateways in an internet connecting autonomous networks. It is derived from experiences learned using the EGP.

bps - bits per second

Bridge - a device that expands a Local Area Network by forwarding frames between data link layers associated with two separate cables, usually carrying a common protocol. Bridges can usually be made to filter certain packets (to forward only certain traffic).

Bridge Protocol Data Unit (BPDU) - A message type used by bridges to exchange management and control information.

Broadband - a service or system requiring transmission channels capable of supporting rates greater than the Integrated Services Digital Network (ISDN) primary rate.

Broadband Access - an ISDN access capable of supporting one or more broadband services.

Broadband Connection Oriented Bearer (BCOB) - Information in the SETUP message that indicates the type of service requested by the calling user.

BCOB-A (Bearer Class A) - Indicated by ATM end user in SETUP message for connection-oriented, constant bit rate service. The network may perform internetworking based on AAL information element (IE).

BCOB-C (Bearer Class C) - Indicated by ATM end user in SETUP message for connection-oriented, variable bit rate service. The network may perform internetworking based on AAL information element (IE).

BCOB-X (Bearer Class X) - Indicated by ATM end user in SETUP message for ATM transport service where AAL, traffic type and timing requirements are transparent to the network.

Broadband Integrated Services Digital Network (B-ISDN) - a common digital network suitable for voice, video, and high-speed data services running at rates beginning at 155 Mbps.

Broadband ISDN User's Part (B-ISUP) - A protocol used to establish, maintain and release broadband switched network connections across an SS7 / ATM network.

Broadband Terminal Equipment (B-TE) - An equipment category for B-ISDN which includes terminal adapters and terminals.

Broadcast - Data transmission to all addresses or functions.

Broadcast and Unknown Server (BUS) - in an emulated LAN, the BUS is responsible for accepting broadcast, multicast, and unknown unicast packets from the LECs to the broadcast MAC address (FFFFFFFFFFFF) via dedicated point-to-point connections, and forwarding the packets to all of the members of the ELAN using a single point-to-multipoint connection.

Brouter (bridging/router) - a device that routes some protocols and bridges others based on configuration information.

Buffer - A data storage medium used to compensate of a difference in rate of data flow or time of occurrence of events when transmitting data from one device to another.

Building Integrated Timing Supply (BITS) - a master timing supply for an entire building, which is a master clock and its ancillary equipment. The BITS supplies DS1 and / or composite clock timing references for synchronization to all other clocks and timing sources in that building.

Bursty Errored Seconds (BES) - a BES contains more than 1 and fewer than 320 path coding violation error events, and no severely errored frame or AIS defects. Controlled slips are not included in determining BESs.

Bursty Second - a second during which there were at least the set number of BES threshold event errors but fewer than the set number of SES threshold event errors.

Byte - A computer-readable group of bits (normally 8 bits in length).

Call - an association between two or more users or between a user and a network entity that is established by the use of network capabilities. This association may have zero or more connections.

Carrier - a company, such as any of the "baby Bell" companies, that provide network communications services, either within a local area or between local areas.

Carrier Group Alarm (CGA) - A service alarm generated by a channel bank when an out-of-frame (OOF) condition exists for some predetermined length of time (generally 300 milliseconds to 2.5 seconds). The alarm causes the calls using a trunk to be dropped and trunk conditioning to be applied.

Carrier Identification Parameter (CIP) - A 3 or 4 digit code in the initial address message identifying the carrier to be used for the connection.

cchan - a FORE program that manages virtual channels on a *ForeRunner* switch running `asxd`.

Cell - an ATM Layer protocol data unit (PDU). The basic unit of information transported in ATM technology, each 53-byte cell contains a 5-byte header and a 48-byte payload.

Cell Delay Variation (CDV) - a quantification of cell clumping for a connection. The cell clumping CDV (yk) is defined as the difference between a cell's expected reference arrival time (ck) and its actual arrival time (ak). The expected reference arrival time (ck) of cell k of a specific connection is max. T is the reciprocal of the negotiated peak cell rate.

Cell Delineation - the protocol for recognizing the beginning and end of ATM cells within the raw serial bit stream.

Cell Header - ATM Layer protocol control information.

Cell Loss Priority (CLP) - the last bit of byte four in an ATM cell header; indicates the eligibility of the cell for discard by the network under congested conditions. If the bit is set to 1, the cell may be discarded by the network depending on traffic conditions.

Cell Loss Ratio - In a network, cell loss ratio is (1-x/y), where y is the number of cells that arrive in an interval at an ingress of the network; and x is the number of these y cells that leave at the egress of the network element.

Cell Loss Ratio (CLR) - CLR is a negotiated QoS parameter and acceptable values are network specific. The objective is to minimize CLR provided the end-system adapts the traffic to the changing ATM layer transfer characteristics. The Cell Loss Ratio is defined for a connection as: Lost Cells/Total Transmitted Cells. The CLR parameter is the value of CLR that the network agrees to offer as an objective over the lifetime of the connection. It is expressed as an order of magnitude, having a range of 10-1 to 10-15 and unspecified.

Cell Misinsertion Rate (CMR) - the ratio of cells received at an endpoint that were not originally transmitted by the source end in relation to the total number of cells properly transmitted.

Cell Rate Adaptation (CRA) - a function performed by a protocol module in which empty cells (known as unassigned cells) are added to the output stream. This is because there always must be a fixed number of cells in the output direction; when there are not enough cells to transmit, unassigned cells are added to the output data stream.

Cell Relay Service (CRS) - a carrier service which supports the receipt and transmission of ATM cells between end users in compliance with ATM standards and implementation specifications.

Cell Transfer Delay - the transit delay of an ATM cell successfully passed between two designated boundaries. See CTD.

Cell Transfer Delay (CTD) - This is defined as the elapsed time between a cell exit event at the measurement point 1 (e.g., at the source UNI) and the corresponding cell entry event at the measurement point 2 (e.g., the destination UNI) for a particular connection. The cell transfer delay between two measurement points is the sum of the total inter-ATM node transmission delay and the total ATM node processing delay.

Channel - A path or circuit along which information flows.

Channel Associated Signaling (CAS) - a form of circuit state signaling in which the circuit state is indicated by one or more bits of signaling status sent repetitively and associated with that specific circuit.

Channel Bank - A device that multiplexes many slow speed voice or data conversations onto high speed link and controls the flow.

Channel Service Unit (CSU) - An interface for digital leased lines which performs loopback testing and line conditioning.

Channelization - capability of transmitting independent signals together over a cable while still maintaining their separate identity for later separation.

Circuit - A communications link between points.

Circuit Emulation Service (CES) - The ATM Forum circuit emulation service interoperability specification specifies interoperability agreements for supporting Constant Bit Rate (CBR) traffic over ATM networks that comply with the other ATM Forum interoperability agreements. Specifically, this specification supports emulation of existing TDM circuits over ATM networks.

Classical IP (CLIP) - IP over ATM which conforms to RFC 1577.

Clear to Send (CTS) - and RS-232 modem interface control signal (sent from the modem to the DTE on pin 5) which indicates that the attached DTE may begin transmitting; issuance in response to the DTE's RTS.

Clocking - Regularly timed impulses.

Closed User Group - A subgroup of network users that can be its own entity; any member of the subgroup can only communicate with other members of that subgroup.

Coaxial Cable - Coax is a type of electrical communications medium used in the LAN environment. This cable consists of an outer conductor concentric to an inner conductor, separated from each other by insulating material, and covered by some protective outer material. This medium offers large bandwidth, supporting high data rates with high immunity to electrical interference and a low incidence of errors. Coax is subject to distance limitations and is relatively expensive and difficult to install.

Cold Start Trap - an SNMP trap which is sent after a power-cycle (see *trap*).

Collision - Overlapping transmissions that occur when two or more nodes on a LAN attempt to transmit at or about the same time.

Committed Information Rate (CIR) - CIR is the information transfer rate which a network offering Frame Relay Services (FRS) is committed to transfer under normal conditions. The rate is averaged over a minimum increment of time.

Common Channel Signaling (CCS) - A form signaling in which a group of circuits share a signaling channel. Refer to SS7.

Common Management Interface Protocol (CMIP) - An ITU-TSS standard for the message formats and procedures used to exchange management information in order to operate, administer maintain and provision a network.

Concatenation - The connection of transmission channels similar to a chain.

Concentrator - a communications device that offers the ability to concentrate many lower-speed channels into and out of one or more high-speed channels.

Configuration - The phase in which the LE Client discovers the LE Service.

Congestion Management - traffic management feature that helps ensure reasonable service for VBR connections in an ATM network, based on a priority, sustained cell rate (SCR), and peak cell rate (PCR). During times of congestion, bandwidth is reduced to the SCR, based on the priority of the connection.

Connection - the concatenation of ATM Layer links in order to provide an end-to-end information transfer capability to access points.

Connection Admission Control (CAC) - the procedure used to decide if a request for an ATM connection can be accepted based on the attributes of both the requested connection and the existing connections.

Connection Endpoint (CE) - a terminator at one end of a layer connection within a SAP.

Connection Endpoint Identifier (CEI) - an identifier of a CE that can be used to identify the connection at a SAP.

Connectionless Broadband Data Service (CBDS) - A connectionless service similar to Bellcore's SMDS defined by European Telecommunications Standards Institute (ETSI).

Connectionless Service - a type of service in which no pre-determined path or link has been established for transfer of information, supported by AAL 4.

Connectionless Service (CLS) - A service which allows the transfer of information among service subscribers without the need for end-to- end establishment procedures.

Connection-Oriented Service - a type of service in which information always traverses the same pre-established path or link between two points, supported by AAL 3.

Constant Bit Rate (CBR) - a type of traffic that requires a continuous, specific amount of bandwidth over the ATM network (e.g., digital information such as video and digitized voice).

Controlled Slip (CS) - a situation in which one frame's worth of data is either lost or replicated. A controlled slip typically occurs when the sending device and receiving device are not using the same clock.

Convergence Sublayer (CS) - a portion of the AAL. Data is passed first to the CS where it is divided into rational, fixed-length packets or PDUs (Protocol Data Units). For example, AAL 4 processes user data into blocks that are a maximum of 64 kbytes long.

Corresponding Entities - peer entities with a lower layer connection among them.

cpath - a FORE program used to manage virtual paths on a *ForeRunner* switch running asxd.

cport - a FORE program that monitors and changes the state of ports on a *ForeRunner* switch running asxd.

Cross Connection - a mapping between two channels or paths at a network device.

Customer Premise Equipment (CPE) - equipment that is on the customer side of the point of demarcation, as opposed to equipment that is on a carrier side. See also point of demarcation.

Cut Through - Establishment of a complete path for signaling and/or audio communications.

Cyclic Redundancy Check (CRC) - an error detection scheme in which a number is derived from the data that will be transmitted. By recalculating the CRC at the remote end and comparing it to the value originally transmitted, the receiving node can detect errors.

D3/D4 - Refers to compliance with AT&T TR (Technical Reference) 62411 definitions for coding, supervision, and alarm support. D3/D4 compatibility ensures support of digital PBXes, M24 services, Megacom services, and Mode 3 D3/D4 channel banks at DS-1 level.

D4 Channelization - refers to compliance with AT&T Technical Reference 62411 regarding DS1 frame layout (the sequential assignment of channels and time slot numbers within the DS1).

D4 Framed/Framing Format - in T1, a 193-bit frame format in which the 193rd bit is used for framing and signaling information (the frame/framing bit). To be considered in support of D4 Framing, a device must be able to synchronize and frame-up on the 193rd bit.

Data Communications Equipment (DCE) - a definition in the RS232C standard that describes the functions of the signals and the physical characteristics of an interface for a communication device such as a modem.

Data Country Code (DCC) - This specifies the country in which an address is registered. The codes are given in ISO 3166. The length of this field is two octets. The digits of the data country code are encoded in Binary Coded Decimal (BCD) syntax. The codes will be left justified and padded on the right with the hexadecimal value “F” to fill the two octets.

Data Link - Communications connection used to transmit data from a source to a destination.

Data Link Connection Identifier (DLCI) - connection identifier associated with frame relay packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

Data Link Layer - Layer 2 of the OSI model, responsible for encoding data and passing it to the physical medium. The IEEE divides this layer into the LLC (Logical Link Control) and MAC (Media Access Control) sublayers.

Data Set Ready (DSR) - an RS-232 modem interface control signal (sent from the modem to the DTE on pin 6) which indicates that the modem is connected to the telephone circuit. Usually a prerequisite to the DTE issuing RTS.

Data Terminal Equipment (DTE) - generally user devices, such as terminals and computers, that connect to data circuit-terminating equipment. They either generate or receive the data carried by the network.

Data Terminal Ready (DTR) - an RS232 modem interface control signal (sent from the DTE to the modem on pin 20) which indicates that the DTE is ready for data transmission and which requests that the modem be connected to the telephone circuit.

Datagram - a packet of information used in a connectionless network service that is routed to its destination using an address included in the datagram's header.

DECnet - Digital Equipment Corporation's proprietary LAN.

Defense Advanced Research Projects Agency (DARPA) - the US government agency that funded the ARPANET.

Demultiplexing - a function performed by a layer entity that identifies and separates SDUs from a single connection to more than one connection (see *multiplexing*).

Destination End Station (DES) - An ATM termination point which is the destination for ATM messages of a connection and is used as a reference point for ABR services. See SES.

Digital Access and Cross-Connect System (DACS) - Digital switching system for routing T1 lines, and DS-0 portions of lines, among multiple T1 ports.

Digital Cross-connect System (DCS) - an electronic patch panel used to route digital signals in a central office.

Digital Standard n (0, 1, 1C, 2, and 3) (DSn) - a method defining the rate and format of digital hierarchy, with asynchronous data rates defined as follows:

DS0	64kb / s	1 voice channel
DS1	1.544Mb / s	24 DS0s
DS1C	3.152 Mb / s	2 DS1s
DS2	6.312 Mb / s	4 DS1s
DS3	44.736 Mb / s	28 DS1s

Synchronous data rates (SONET) are defined as:

STS-1 / OC-1	51.84 Mb / s	28 DS1s or 1 DS3
STS-3 / OC-3	155.52 Mb / s	3 STS-1s byte interleaved
STS-3c / OC-3c	155.52 Mb / s	Concatenated, indivisible payload
STS-12 / OC-12	622.08 Mb / s	12 STS-1s, 4 STS-3cs, or any mixture
STS-12c / OC-12c	622.08 Mb / s	Concatenated, indivisible payload
STS-48 / OC-48	2488.32 Mb / s	48 STS-1s, 16 STS-3cs, or any mixture

DIP (Dual In-line Package) Switch - a device that has two parallel rows of contacts that let the user switch electrical current through a pair of those contacts to on or off. They are used to reconfigure components and peripherals.

Domain Name Server - a computer that converts names to their corresponding Internet numbers. It allows users to telnet or FTP to the name instead of the number.

Domain Naming System (DNS) - the distributed name and address mechanism used in the Internet.

Duplex - Two way communication.

DXI - a generic phrase used in the full names of several protocols, all commonly used to allow a pair of DCE and DTE devices to share the implementation of a particular WAN protocol. The protocols define the packet formats used to transport data between DCE and DTE devices.

DXI Frame Address (DFA) - a connection identifier associated with ATM DXI packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

Dynamic Allocation - A technique in which the resources assigned for program execution are determined by criteria applied at the moment of need.

E.164 - A public network addressing standard utilizing up to a maximum of 15 digits. ATM uses E.164 addressing for public network addressing.

E1 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 2.048 Mbps. E1 lines can be leased for private use from common carriers.

E3 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 34.368 Mbps. E3 lines can be leased for private use from common carriers.

Edge Device - A physical device which is capable of forwarding packets between legacy interworking interfaces (e.g., Ethernet, Token Ring, etc.) and ATM interfaces based on data-link and network layer information but which does not participate in the running of any network layer routing protocol. An Edge Device obtains forwarding descriptions using the route distribution protocol.

elarp - a FORE program that shows and manipulates MAC and ATM address mappings for LAN Emulation Clients (LECs).

elconfig - a FORE program that shows and modifies LEC configuration. Lets the user set the NSAP address of the LAN Emulation Configuration Server, display the list of Emulated LANs configured in the LECS for this host, display the list of ELANs locally configured along with the membership state of each, and locally administer ELAN membership.

Electrically Erasable Programmable Read Only Memory (EEPROM) - an EPROM that can be cleared with electrical signals rather than the traditional ultraviolet light.

Electromagnetic Interference (EMI) - signals generated and radiated by an electronic device that cause interference with radio communications, among other effects.

Electronics Industries Association (EIA) - a USA trade organization that issues its own standards and contributes to ANSI; developed RS-232. Membership includes USA manufacturers.

Embedded SNMP Agent - an SNMP agent can come in two forms: embedded or proxy. An embedded SNMP agent is integrated into the physical hardware and software of the unit.

Emulated Local Area Network (ELAN) - A logical network initiated by using the mechanisms defined by LAN Emulation. This could include ATM and legacy attached end stations.

End System (ES) - a system where an ATM connection is terminated or initiated (an originating end system initiates the connection; a terminating end system terminates the connection).

End System Identifier (ESI) - This identifier distinguishes multiple nodes at the same level in case the lower level peer group is partitioned.

End-to-End Connection - when used in reference to an ATM network, a connection that travels through an ATM network, passing through various ATM devices and with endpoints at the termination of the ATM network.

Enterprise - Terminology generally referring to customers with multiple, non-contiguous geographic locations.

Equalization (EQL) - the process of compensating for line distortions.

Erasable Programmable Read Only Memory (EPROM) - A PROM which may be erased and rewritten to perform new or different functions (normally done with a PROM burner).

Errored Second (ES) - a second during which at least one code violation occurred.

Ethernet - a 10-Mbps, coaxial standard for LANs in which all nodes connect to the cable where they contend for access.

Excessive Zeroes (EXZ) Error Event - An Excessive Zeroes error event for an AMI-coded signal is the occurrence of more than fifteen contiguous zeroes. For a B8ZS coded signal, the defect occurs when more than seven contiguous zeroes are detected.

Explicit Forward Congestion Indication (EFCI) - the second bit of the payload type field in the header of an ATM cell, the EFCI bit indicates network congestion to receiving hosts. On a congested switch, the EFCI bit is set to "1" by the transmitting network module when a certain number of cells have accumulated in the network module's shared memory buffer. When a cell is received that has its EFCI bit set to "1," the receiving host notifies the sending host, which should then reduce its transmission rate.

Explicit Rate (ER) - The Explicit Rate is an RM-cell field used to limit the source ACR to a specific value. It is initially set by the source to a requested rate (such as PCR). It may be subsequently reduced by any network element in the path to a value that the element can sustain. ER is formatted as a rate.

Extended Industry Standard Architecture (EISA) - bus architecture for desktop computers that provides a 32-bit data passage and maintains compatibility with the ISA or AT architecture.

Extended Super Frame (ESF) - a T1 framing format that utilizes the 193rd bit as a framing bit, but whose Superframe is made up of 24 frames instead of 12 as in D4 format. ESF also provides CRC error detection and maintenance data link functions.

Exterior Gateway Protocol (EGP) - used by gateways in an internet, connecting autonomous networks.

Fairness - related to Generic Flow Control, fairness is defined as meeting all of the agreed quality of service requirements by controlling the order of service for all active connections.

Far End Block Error (FEBE) - an error detected by extracting the 4-bit FEBE field from the path status byte (G1). The legal range for the 4-bit field is between 0000 and 1000, representing zero to eight errors. Any other value is interpreted as zero errors.

Far End Receive Failure (FERF) - a line error asserted when a 110 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. A line FERF is removed when any pattern other than 110 is detected in these bits for five consecutive frames.

Far-End - in a relationship between two devices in a circuit, the far-end device is the one that is remote.

Face Contact (FC) - Designation for fiber optic connector designed by Nippon Telegraph and Telephone which features a movable anti-rotation key allowing good repeatable performance despite numerous mating. Normally referred to as Fiber Connector, FC actually stands for Face Contact and sometimes linked with PC (Point Contact), designated as FC or FC-PC.

FCC Part 68 - The FCC rules regulating the direct connection of non-telephone company provided equipment to the public telephone network.

Federal Communications Commission (FCC) - a board of commissioners appointed by the President under the Communications Act of 1934, with the authority to regulate all interstate telecommunications originating in the United States, including transmission over phone lines.

Fiber Distributed Data Interface (FDDI) - high-speed data network that uses fiber-optic as the physical medium. Operates in similar manner to Ethernet or Token Ring, only faster.

File Transfer Protocol (FTP) - a TCP/IP protocol that lets a user on one computer access, and transfer data to and from, another computer over a network. ftp is usually the name of the program the user invokes to accomplish this task.

First-In, First-Out (FIFO) - method of coordinating the sequential flow of data through a buffer.

Flag - a bit pattern of six binary "1"s bounded by a binary "0" at each end (forms a 0111 1110 or Hex "7E"). It is used to mark the beginning and/or end of a frame.

Flow Control - The way in which information is controlled in a network to prevent loss of data when the receiving buffer is near its capacity.

***ForeThought* PNNI (FT-PNNI) -** a FORE Systems routing and signalling protocol that uses private ATM (NSAP) addresses; a precursor to ATM Forum PNNI (see PNNI).

Forward Error Correction (FEC) - A technique used by a receiver for correcting errors incurred in transmission over a communications channel without requiring retransmission of any information by the transmitter; typically involves a convolution of the transmitted bits and the appending of extra bits by both the receiver and transmitter using a common algorithm.

Forward Explicit Congestion Notification (FECN) - Bit set by a Frame Relay network to inform data terminal equipment (DTE) receiving the frame that congestion was experienced in the path from source to destination. DTE receiving frames with the FECN bit set can request that higher-level protocols take flow control action as appropriate.

Fractional T1 - the use of bandwidth in 64Kbps increments up to 1.544Mbps from a T1 facility.

Frame - a variable length group of data bits with a specific format containing flags at the beginning and end to provide demarcation.

Frame Check Sequence (FCS) - In bit-oriented protocols, a 16-bit field that contains transmission error checking information, usually appended to the end of the frame.

Frame Relay - a fast packet switching protocol based on the LAPD protocol of ISDN that performs routing and transfer with less overhead processing than X.25.

Frame Synchronization Error - an error in which one or more time slot framing bits are in error.

Frame-Based UNI (FUNI) - An ATM switch-based interface which accepts frame-based ATM traffic and converts it into cells.

Frame-Relay Service (FRS) - A connection oriented service that is capable of carrying up to 4096 bytes per frame.

Framing - a protocol that separates incoming bits into identifiable groups so that the receiving multiplexer recognizes the grouping.

Frequency Division Multiplexing (FDM) - a method of dividing an available frequency range into parts with each having enough bandwidth to carry one channel.

Gbps - gigabits per second (billion)

Generic Cell Rate Algorithm (GCRA) - an algorithm which is employed in traffic policing and is part of the user / network service contract. The GCRA is a scheduling algorithm which ensures that cells are marked as conforming when they arrive when expected or later than expected and non-conforming when they arrive sooner than expected.

Generic Connection Admission Control (GCAC) - This is a process to determine if a link has potentially enough resources to support a connection.

Generic Flow Control (GFC) - the first four bits of the first byte in an ATM cell header. Used to control the flow of traffic across the User-to-Network Interface (UNI), and thus into the network. Exact mechanisms for flow control are still under investigation and no explicit definition for this field exists at this time. (This field is used only at the UNI; for NNI-NNI use (between network nodes), these four bits provide additional network address capacity, and are appended to the VPI field.)

GIO - a proprietary bus architecture used in certain Silicon Graphics, Inc. workstations.

Header - protocol control information located at the beginning of a protocol data unit.

Header Error Control (HEC) - a CRC code located in the last byte of an ATM cell header that is used for checking cell header integrity only.

High Density Bipolar (HDB3) - A bipolar coding method that does not allow more than 3 consecutive zeroes.

High Level Data Link Control (HDLC) - An ITU-TSS link layer protocol standard for point-to-point and multi-point communications.

High Performance Parallel Interface (HIPPI) - ANSI standard that extends the computer bus over fairly short distances at speeds of 800 and 1600 Mbps.

High-Speed Serial Interface (HSSI) - a serial communications connection that operates at speeds of up to 1.544 Mbps.

Host - In a network, the primary or controlling computer in a multiple computer installation.

HPUX - the Hewlett-Packard version of UNIX.

Hub - a device that connects several other devices, usually in a star topology.

I/O Module - FORE's interface cards for the LAX-20 LAN Access Switch, designed to connect Ethernet, Token Ring, and FDDI LANs to *ForeRunner* ATM networks.

Institute of Electrical and Electronics Engineers (IEEE) - the world's largest technical professional society. Based in the U.S., the IEEE sponsors technical conferences, symposia & local meetings worldwide, publishes nearly 25% of the world's technical papers in electrical, electronics & computer engineering, provides educational programs for members, and promotes standardization.

IEEE 802 - Standards for the interconnection of LAN computer equipment. Deals with the Data Link Layers of the ISO Reference Model for OSI.
IEEE 802.1 - Defines the high-level network interfaces such as architecture, internetworking and network management.
IEEE 802.2 - Defines the Logical Link Control interface between the Data Link and Network Layers.
IEEE 802.3 - Defines CSMA / CD (Ethernet).
IEEE 802.4 - Defines the token-passing bus.
IEEE 802.5 - Defines the Token Ring access methodology. This standard incorporates IBM's Token Ring specifications.
IEEE 802.6 - Defines Metropolitan Area Networks.
IEEE 802.7 - The broadband technical advisory group.
IEEE 802.8 - The fiber optics technical advisory group.
IEEE 802.9 - Defines integrated data and voice networks.

Integrated Services Digital Network (ISDN) - an emerging technology that is beginning to be offered by the telephone carriers of the world. ISDN combines voice and digital network services into a single medium or wire.

Interexchange Carriers (IXC) - Long-distance communications companies that provide service between Local Access Transport Areas (LATAs).

Interface Data - the unit of information transferred to / from the upper layer in a single interaction across a SAP. Each Interface Data Unit (IDU) controls interface information and may also contain the whole or part of the SDU.

Interface Data Unit (IDU) - The unit of information transferred to / from the upper layer in a single interaction across the SAP. Each IDU contains interface control information and may also contain the whole or part of the SDU.

Interim Local Management Interface (ILMI) - the standard that specifies the use of the Simple Network Management Protocol (SNMP) and an ATM management information base (MIB) to provide network status and configuration information.

Intermediate System (IS) - a system that provides forwarding functions or relaying functions or both for a specific ATM connection. OAM cells may be generated and received.

International Standards Organization (ISO) - a voluntary, non treaty organization founded in 1946 that is responsible for creating international standards in many areas, including computers and communications.

International Telephone and Telegraph Consultative Committee (CCITT) - the international standards body for telecommunications.

Internet - (note the capital "I") the largest internet in the world including large national backbone nets and many regional and local networks worldwide. The Internet uses the TCP/IP suite. Networks with only e-mail connectivity are not considered on the Internet.

internet - while an internet is a network, the term "internet" is usually used to refer to a collection of networks interconnected with routers.

Internet Addresses - the numbers used to identify hosts on an internet network. Internet host numbers are divided into two parts; the first is the network number and the second, or local, part is a host number on that particular network. There are also three classes of networks in the Internet, based on the number of hosts on a given network. Large networks are classified as Class A, having addresses in the range 1-126 and having a maximum of 16,387,064 hosts. Medium networks are classified as Class B, with addresses in the range 128-191 and with a maximum of 64,516 hosts. Small networks are classified as Class C, having addresses in the range 192-254 with a maximum of 254 hosts. Addresses are given as dotted decimal numbers in the following format:

nnn.nnn.nnn.nnn

In a Class A network, the first of the numbers is the network number, the last three numbers are the local host address.

In a Class B network, the first two numbers are the network, the last two are the local host address.

In a Class C network, the first three numbers are the network address, the last number is the local host address.

The following table summarizes the classes and sizes:

Class	First #	Max# Hosts
A	1-126	16,387,064
B	129-191	64,516
C	192-223	254

Network mask values are used to identify the network portion and the host portion of the address. Default network masks are as follows:

Class A - 255.0.0.0

Class B - 255.255.0.0

Class C - 255.255.255.0

Subnet masking is used when a portion of the host ID is used to identify a subnetwork. For example, if a portion of a Class B network address is used for a subnetwork, the mask could be set as 255.255.255.0. This would allow the third byte to be used as a subnetwork address. All hosts on the network would still use the IP address to get on the Internet.

Internet Control Message Protocol (ICMP) - the protocol that handles errors and control messages at the IP layer. ICMP is actually a part of the IP protocol layer. It can generate error messages, test packets, and informational messages related to IP.

Internet Engineering Task Force (IETF) - a large, open, international community of network designers, operators, vendors and researchers whose purpose is to coordinate the operation, management and evolution of the Internet to resolve short- and mid-range protocol and architectural issues.

Internet Protocol (IP) - a connectionless, best-effort packet switching protocol that offers a common layer over dissimilar networks.

Internetwork Packet Exchange (IPX) Protocol - a NetWare protocol similar to the Xerox Network Systems (XNS) protocol that provides datagram delivery of messages.

Interoperability - The ability of software and hardware on multiple machines, from multiple vendors, to communicate.

Interworking Function (IWF) - provides a means for two different technologies to interoperate.

IP Address - a unique 32-bit integer used to identify a device in an IP network. You will most commonly see IP addresses written in "dot" notation (e.g., 192.228.32.14).

IP Netmask - a 32-bit pattern that is combined with an IP address to determine which bits of an IP address denote the network number and which denote the host number. Netmasks are useful for sub-dividing IP networks. IP netmasks are written in "dot" notation (e.g., 255.255.0.0).

ISA Bus - a bus standard developed by IBM for expansion cards in the first IBM PC. The original bus supported a data path only 8 bits wide. IBM subsequently developed a 16-bit version for its AT class computers. The 16-bit AT ISA bus supports both 8- and 16-bit cards. The 8-bit bus is commonly called the PC / XT bus, and the 16-bit bus is called the AT bus.

Isochronous - signals carrying embedded timing information or signals that are dependent on uniform timing; usually associated with voice and / or video transmission.

International Telecommunications Union Telecommunications (ITU-T) - an international body of member countries whose task is to define recommendations and standards relating to the international telecommunications industry. The fundamental standards for ATM have been defined and published by the ITU-T (Previously CCITT).

J2 - Wide-area digital transmission scheme used predominantly in Japan that carries data at a rate of 6.312 Mbps.

Jitter - analog communication line distortion caused by variations of a signal from its reference timing position.

Joint Photographic Experts Group (JPEG) - An ISO Standards group that defines how to compress still pictures.

Jumper - a patch cable or wire used to establish a circuit, often temporarily, for testing or diagnostics; also, the devices, shorting blocks, used to connect adjacent exposed pins on a printed circuit board that control the functionality of the card.

Kbps - kilobits per second (thousand)

LAN Access Concentrator - a LAN access device that allows a shared transmission medium to accommodate more data sources than there are channels currently available within the transmission medium.

LAN Emulation Address Resolution Protocol (LE_ARP) - A message issued by a LE client to solicit the ATM address of another function.

LAN Emulation Client (LEC) - the component in an end system that performs data forwarding, address resolution, and other control functions when communicating with other components within an ELAN.

LAN Emulation Configuration Server (LECS) - the LECS is responsible for the initial configuration of LECs. It provides information about available ELANs that a LEC may join, together with the addresses of the LES and BUS associated with each ELAN.

LAN Emulation Server (LES) - the LES implements the control coordination function for an ELAN by registering and resolving MAC addresses to ATM addresses.

LAN Emulation (LANE) - technology that allows an ATM network to function as a LAN backbone. The ATM network must provide multicast and broadcast support, address mapping (MAC-to-ATM), SVC management, and a usable packet format. LANE also defines Ethernet and Token Ring ELANs.

lane - a program that provides control over the execution of the LAN Emulation Server (LES), Broadcast/Unknown Server (BUS), and LAN Emulation Configuration Server (LECS) on the local host.

Latency - The time interval between a network station seeking access to a transmission channel and that access being granted or received.

Layer Entity - an active layer within an element.

Layer Function - a part of the activity of the layer entities.

Layer Service - a capability of a layer and the layers beneath it that is provided to the upper layer entities at the boundary between that layer and the next higher layer.

Layer User Data - the information transferred between corresponding entities on behalf of the upper layer or layer management entities for which they are providing services.

le - a FORE program that implements both the LAN Emulation Server (LES) and the Broadcast/Unknown Server (BUS).

Leaky Bucket - informal cell policing term for the Generic Cell Rate Algorithm which in effect receives cells into a bucket and leaks them out at the specified or contracted rate (i.e., PCR).

Least Significant Bit (LSB) - lowest order bit in the binary representation of a numerical value.

lecs - a FORE program that implements the assignment of individual LECs to different emulated LANs.

leq - a FORE program that provides information about an ELAN. This information is obtained from the LES, and includes MAC addresses registered on the ELAN together with their corresponding ATM addresses.

Line Build Out (LBO) - Because T1 circuits require the last span to lose 15-22.5 dB, a selectable output attenuation is generally required of DTE equipment (typical selections include 0.0, 7.5 and 15 dB of loss at 772 KHz).

Line Code Violations (LCV) - Error Event. A Line Coding Violation (LCV) is the occurrence of either a Bipolar Violation (BPV) or Excessive Zeroes (EXZ) Error Event.

Link - An entity that defines a topological relationship (including available transport capacity) between two nodes in different subnetworks. Multiple links may exist between a pair of subnetworks. Synonymous with logical link.

Link Access Procedure, Balanced (LAPB) - Data link protocol in the X.25 protocol stack. LAPB is a bit-oriented protocol derived from HDLC. See also HDLC and X.25.

Link Down Trap - an SNMP trap, sent when an interface changes from a normal state to an error state, or is disconnected.

Link Layer - layer in the OSI model regarding transmission of data between network nodes.

Link Up Trap - an SNMP trap, sent when an interface changes from an error condition to a normal state.

Load Sharing - Two or more computers in a system that share the load during peak hours. During periods of non peak hours, one computer can manage the entire load with the other acting as a backup.

Local Access and Transport Area (LATA) - Geographic boundaries of the local telephone network, specified by the FCC, in which a single LEC may perform its operations. Communications outside or between LATAs are provided by IXCs.

Local Area Network (LAN) - a data network intended to serve an area of only a few square kilometers or less. Because the network is known to cover only a small area, optimizations can be made in the network signal protocols that permit higher data rates.

Logical Link Control (LLC) - protocol developed by the IEEE 802 committee for data-link-layer transmission control; the upper sublayer of the IEEE Layer 2 (OSI) protocol that complements the MAC protocol; IEEE standard 802.2; includes end-system addressing and error checking.

Loopback - a troubleshooting technique that returns a transmitted signal to its source so that the signal can be analyzed for errors. Typically, a loopback is set at various points in a line until the section of the line that is causing the problem is discovered.

looptest - program that tests an interface for basic cell reception and transmission functionality, usually used for diagnostic purposes to determine if an interface is functioning properly.

Loss Of Frame (LOF) - a type of transmission error that may occur in wide-area carrier lines.

Loss Of Pointer (LOP) - a type of transmission error that may occur in wide-area carrier lines.

Loss Of Signal (LOS) - a type of transmission error that may occur in wide-area carrier lines, or a condition declared when the DTE senses a loss of a DS1 signal from the CPE for more the 150 milliseconds (the DTE generally responds with an all ones “Blue or AIS” signal).

Management Information Base (MIB) - the set of parameters that an SNMP management station can query or set in the SNMP agent of a networked device (e.g., router).

Maximum Burst Size (MBS) - the Burst Tolerance (BT) is conveyed through the MBS which is coded as a number of cells. The BT together with the SCR and the GCRA determine the MBS that may be transmitted at the peak rate and still be in conformance with the GCRA.

Maximum Burst Tolerance - the largest burst of data that a network device is guaranteed to handle without discarding cells or packets. Bursts of data larger than the maximum burst size may be subject to discard.

Maximum Cell Delay Variance (MCDV) - This is the maximum two-point CDV objective across a link or node for the specified service category.

Maximum Cell Loss Ratio (MCLR) - This is the maximum ratio of the number of cells that do not make it across the link or node to the total number of cells arriving at the link or node.

Maximum Cell Transfer Delay (MCTD) - This is the sum of the fixed delay component across the link or node and MCDV.

Maximum Transmission Unit (MTU) - the largest unit of data that can be sent over a type of physical medium.

Mbps - megabits per second (million)

Media Access Control (MAC) - a media-specific access control protocol within IEEE 802 specifications; currently includes variations for Token Ring, token bus, and CSMA/CD; the lower sublayer of the IEEE’s link layer (OSI), which complements the Logical Link Control (LLC).

Media Attachment Unit (MAU) - device used in Ethernet and IEEE 802.3 networks that provides the interface between the AUI port of a station and the common medium of the Ethernet. The MAU, which can be built into a station or can be a separate device, performs physical layer functions including conversion of the digital data from the Ethernet interface, collision detection, and injection of bits onto the network.

Media Interface Connector (MIC) - fiber optic connector that joins fiber to the FDDI controller.

Message Identifier (MID) - message identifier used to associate ATM cells that carry segments from the same higher layer packet.

Metasignalling - an ATM Layer Management (LM) process that manages different types of signalling and possibly semipermanent virtual channels (VCs), including the assignment, removal, and checking of VCs.

Metasignalling VCs - the standardized VCs that convey metasignalling information across a User-to-Network Interface (UNI).

Metropolitan Area Network (MAN) - network designed to carry data over an area larger than a campus such as an entire city and its outlying area.

MicroChannel - a proprietary 16- or 32-bit bus developed by IBM for its PS/2 computers' internal expansion cards; also offered by others.

Minimum Cell Rate (MCR) - parameter defined by the ATM Forum for ATM traffic management, defined only for ABR transmissions and specifying the minimum value for the ACR.

Most Significant Bit (MSB) - highest order bit in the binary representation of a numerical value.

Motion Picture Experts Group (MPEG) - ISO group dealing with video and audio compression techniques and mechanisms for multiplexing and synchronizing various media streams.

MPOA Client - A device which implements the client side of one or more of the MPOA protocols, (i.e., is a SCP client and/or an RDP client. An MPOA Client is either an Edge Device Functional Group (EDFG) or a Host Behavior Functional Group (HBFG).

MPOA Server - An MPOA Server is any one of an ICFG or RSFG.

MPOA Service Area - The collection of server functions and their clients. A collection of physical devices consisting of an MPOA server plus the set of clients served by that server.

MPOA Target - A set of protocol address, path attributes, (e.g., internetwork layer QoS, other information derivable from received packet) describing the intended destination and its path attributes that MPOA devices may use as lookup keys.

Mu-Law - The PCM coding and companding standard used in Japan and North America.

Multicasting - The ability to broadcast messages to one node or a select group of nodes.

Multi-homed - a device having both an ATM and another network connection, like Ethernet.

Multimode Fiber Optic Cable (MMF) - fiber optic cable in which the signal or light propagates in multiple modes or paths. Since these paths may have varying lengths, a transmitted pulse of light may be received at different times and smeared to the point that pulses may interfere with surrounding pulses. This may cause the signal to be difficult or impossible to receive. This pulse dispersion sometimes limits the distance over which a MMF link can operate.

Multiplexing - a function within a layer that interleaves the information from multiple connections into one connection (see demultiplexing).

Multipoint Access - user access in which more than one terminal equipment (TE) is supported by a single network termination.

Multipoint-to-Multipoint Connection - a collection of associated ATM VC or VP links, and their associated endpoint nodes, with the following properties:

1. All N nodes in the connection, called Endpoints, serve as a Root Node in a Point-to-Multipoint connection to all of the (N-1) remaining endpoints.

2. Each of the endpoints can send information directly to any other endpoint, but the receiving endpoint cannot distinguish which of the endpoints is sending information without additional (e.g., higher layer) information.

Multipoint-to-Point Connection - a Point-to-Multipoint Connection may have zero bandwidth from the Root Node to the Leaf Nodes, and non-zero return bandwidth from the Leaf Nodes to the Root Node. Such a connection is also known as a Multipoint-to-Point Connection.

Multiprotocol over ATM (MPOA) - An effort taking place in the ATM Forum to standardize protocols for the purpose of running multiple network layer protocols over ATM.

Narrowband Channel - sub-voicegrade channel with a speed range of 100 to 200 bps.

National TV Standards Committee (NTSC) - Started in the US in 1953 from a specification laid down by the National Television Standards Committee. It takes the B-Y and R-Y color difference signals, attenuates them to I and Q, then modulates them using double-sideband suppressed subcarrier at 3.58MHz. The carrier reference is sent to the receiver as a burst during the back porch. An industry group that defines how television signals are encoded and transmitted in the US. (See also PAL, SECAM for non-U.S. countries).

Near-End - in a relationship between two devices in a circuit, the near-end device is the one that is local.

Network Layer - Layer three In the OSI model, the layer that is responsible for routing data across the network.

Network Management Entity (NM) - body of software in a switching system that provides the ability to manage the PNNI protocol. NM interacts with the PNNI protocol through the MIB.

Network Management Layer (NML) - an abstraction of the functions provided by systems which manage network elements on a collective basis, providing end-to-end network monitoring.

Network Management Station (NMS) - system responsible for managing a network or portion of a network by talking to network management agents, which reside in the managed nodes.

Network Module - ATM port interface cards which may be individually added to or removed from any *ForeRunner* ATM switch to provide a diverse choice of connection alternatives.

Network Parameter Control (NPC) - Defined as the set of actions taken by the network to monitor and control traffic from the NNI. Its main purpose is to protect network resources from malicious as well as unintentional misbehavior which can affect the QoS of other already established connections by detecting violations of negotiated parameters and taking appropriate actions. Refer to UPC.

Network Redundancy - Duplicated network equipment and/or data which can provide a backup in case of network failures.

Network Service Access Point (NSAP) - OSI generic standard for a network address consisting of 20 octets. ATM has specified E.164 for public network addressing and the NSAP address structure for private network addresses.

Network-to-Network Interface or Network Node Interface (NNI) - the interface between two public network pieces of equipment.

Node - A computer or other device when considered as part of a network.

Non Return to Zero (NRZ) - a binary encoding scheme in which ones and zeroes are represented by opposite and alternating high and low voltages and where there is no return to a zero (reference) voltage between encoded bits.

Non Return to Zero Inverted (NRZI) - A binary encoding scheme that inverts the signal on a "1" and leaves the signal unchanged for a "0". (Also called transition encoding.)

Nonvolatile Storage - Memory storage that does not lose its contents when power is turned off.

NuBus - a high-speed bus used in Macintosh computers, structured so users can put a card into any slot on the board without creating conflict over the priority between those cards.

nx64K - This refers to a circuit bandwidth or speed provided by the aggregation of nx64 kbps channels (where n= integer > 1). The 64K or DS0 channel is the basic rate provided by the T Carrier systems.

Nyquist Theorem - In communications theory, a formula stating that two samples per cycle is sufficient to characterize a bandwidth limited analog signal; in other words, the sampling rate must be twice the highest frequency component of the signal (i.e., sample 4 KHz analog voice channels 8000 times per second).

Object Identifier (OID) - the address of a MIB variable.

Octet - a grouping of 8 bits; similar, but not identical to, a byte.

One's Density - The requirement for digital transmission lines in the public switched telephone network that eight consecutive "0"s cannot be in a digital data stream; exists because repeaters and clocking devices within the network will lose timing after receiving eight "0"s in a row; a number of techniques are used to insert a "1" after every seventh-consecutive "0" (see Bit Stuffing).

Open Shortest Path First (OSPF) Protocol - a routing algorithm for IP that incorporates least-cost, equal-cost, and load balancing.

Open Systems Interconnection (OSI) - the 7-layer suite of protocols designed by ISO committees to be the international standard computer network architecture.

OpenView - Hewlett-Packard's network management software.

Operation and Maintenance (OAM) Cell - a cell that contains ATM LM information. It does not form part of the upper layer information transfer.

Optical Carrier level-n (OC-n) - The optical counterpart of STS-n (the basic rate of 51.84 Mbps on which SONET is based is referred to as OC-1 or STS-1).

Organizationally Unique Identifier (OUI) - Part of RFC 1483. A three-octet field in the SubNetwork Attachment Point (SNAP) header, identifying an organization which administers the meaning of the following two octet Protocol Identifier (PID) field in the SNAP header. Together they identify a distinct routed or bridged protocol.

Out-of-Band Management - refers to switch configuration via the serial port or over Ethernet, not ATM.

Out-of-Frame (OOF) - a signal condition and alarm in which some or all framing bits are lost.

Packet - An arbitrary collection of data grouped and transmitted with its user identification over a shared facility.

Packet Assembler Disassembler (PAD) - interface device that buffers data sent to/from character mode devices, and assembles and disassembles the packets needed for X.25 operation.

Packet Internet Groper (ping) - a program used to test reachability of destinations by sending them an ICMP echo request and waiting for a reply.

Packet Level Protocol (PLP) - Network layer protocol in the X.25 protocol stack. Sometimes called X.25 Level 3 or X.25 Protocol.

Packet Switched Network (PSN) - a network designed to carry data in the form of packets. The packet and its format is internal to that network.

Packet Switching - a communications paradigm in which packets (messages) are individually routed between hosts with no previously established communications path.

Payload Scrambling - a technique that eliminates certain bit patterns that may occur within an ATM cell payload that could be misinterpreted by certain sensitive transmission equipment as an alarm condition.

Payload Type (PT) - bits 2...4 in the fourth byte of an ATM cell header. The PT indicates the type of information carried by the cell. At this time, values 0...3 are used to identify various types of user data, values 4 and 5 indicate management information, and values 6 and 7 are reserved for future use.

Peak Cell Rate - at the PHY Layer SAP of a point-to-point VCC, the Peak Cell Rate is the inverse of the minimum inter-arrival time T0 of the request to send an ATM-SDU.

Peak Cell Rate (PCR) - parameter defined by the ATM Forum for ATM traffic management. In CBR transmissions, PCR determines how often data samples are sent. In ABR transmissions, PCR determines the maximum value of the ACR.

Peer Entities - entities within the same layer.

Peripheral Component Interconnect (PCI) - a local-bus standard created by Intel.

Permanent Virtual Channel Connection (PVCC) - A Virtual Channel Connection (VCC) is an ATM connection where switching is performed on the VPI/VCI fields of each cell. A Permanent VCC is one which is provisioned through some network management function and left up indefinitely.

Permanent Virtual Circuit (or Channel) (PVC) - a circuit or channel through an ATM network provisioned by a carrier between two endpoints; used for dedicated long-term information transport between locations.

Permanent Virtual Path Connection (PVPC) - A Virtual Path Connection (VPC) is an ATM connection where switching is performed on the VPI field only of each cell. A PVPC is one which is provisioned through some network management function and left up indefinitely.

Phase Alternate Line (PAL) - Largely a German/British development in the late 60s, used in the UK and much of Europe. The B-Y and R-Y signals are weighted to U and V, then modulated onto a double-sideband suppressed subcarrier at 4.43MHz. The V (R-Y) signal's phase is turned through 180 degrees on each alternate line. This gets rid of NTSC's hue changes with phase errors at the expense of de-saturation. The carrier reference is sent as a burst in the back porch. The phase of the burst is alternated every line to convey the phase switching of the V signal. The burst's average phase is -V. (see NTSC for U.S.).

Physical Layer (PHY) - the actual cards, wires, and/or fiber-optic cabling used to connect computers, routers, and switches.

Physical Layer Connection - an association established by the PHY between two or more ATM-entities. A PHY connection consists of the concatenation of PHY links in order to provide an end-to-end transfer capability to PHY SAPs.

Physical Layer Convergence Protocol (PLCP) - a framing protocol that runs on top of the T1 or E1 framing protocol.

Physical Medium (PM) - Refers to the actual physical interfaces. Several interfaces are defined including STS-1, STS-3c, STS-12c, STM-1, STM-4, DS1, E1, DS2, E3, DS3, E4, FDDI-based, Fiber Channel-based, and STP. These range in speeds from 1.544Mbps through 622.08 Mbps.

Physical Medium Dependent (PMD) - a sublayer concerned with the bit transfer between two network nodes. It deals with wave shapes, timing recovery, line coding, and electro-optic conversions for fiber based links.

Plesiochronous - two signals are plesiochronous if their corresponding significant instants occur at nominally the same rate, with variations in rate constrained to specified limits.

Point of Demarcation - the dividing line between a carrier and the customer premise that is governed by strict standards that define the characteristics of the equipment on each side of the demarcation. Equipment on one side of the point of demarcation is the responsibility of the customer. Equipment on the other side of the point of demarcation is the responsibility of the carrier.

Point-to-Multipoint Connection - a collection of associated ATM VC or VP links, with associated endpoint nodes, with the following properties:

1. One ATM link, called the Root Link, serves as the root in a simple tree topology. When the Root node sends information, all of the remaining nodes on the connection, called Leaf nodes, receive copies of the information.

2. Each of the Leaf Nodes on the connection can send information directly to the Root Node. The Root Node cannot distinguish which Leaf is sending information without additional (higher layer) information. (See the following note for Phase 1.)

3. The Leaf Nodes cannot communicate directly to each other with this connection type.

Note: Phase 1 signalling does not support traffic sent from a Leaf to the Root.

Point-to-Point Connection - a connection with only two endpoints.

Point-to-Point Protocol (PPP) - Provides a method for transmitting packets over serial point-to-point links.

Policing - the function that ensures that a network device does not accept traffic that exceeds the configured bandwidth of a connection.

Port Identifier - The identifier assigned by a logical node to represent the point of attachment of a link to that node.

Presentation Layer - Sixth layer of the OSI model, providing services to the application layer.

Primary Reference Source (PRS) - Equipment that provides a timing signal whose long-term accuracy is maintained at 1 x 10 -11 or better with verification to universal coordinated time (UTC) and whose timing signal is used as the basis of reference for the control of other clocks within a network.

Primitive - an abstract, implementation-independent interaction between a layer service user and a layer service provider.

Priority - the parameter of ATM connections that determines the order in which they are reduced from the peak cell rate to the sustained cell rate in times of congestion. Connections with lower priority (4 is low, 1 is high) are reduced first.

Private Branch Exchange (PBX) - a private phone system (switch) that connects to the public telephone network and offers in-house connectivity. To reach an outside line, the user must dial a digit like 8 or 9.

Private Network Node Interface or Private Network-to-Network Interface (PNNI) - a protocol that defines the interaction of private ATM switches or groups of private ATM switches

Programmable Read-Only Memory (PROM) - a chip-based information storage area that can be recorded by an operator but erased only through a physical process.

Protocol - a set of rules and formats (semantic and syntactic) that determines the communication behavior of layer entities in the performance of the layer functions.

Protocol Control Information - the information exchanged between corresponding entities using a lower layer connection to coordinate their joint operation.

Protocol Data Unit (PDU) - a unit of data specified in a layer protocol and consisting of protocol control information and layer user data.

Proxy - the process in which one system acts for another system to answer protocol requests.

Proxy Agent - an agent that queries on behalf of the manager, used to monitor objects that are not directly manageable.

Public Data Network (PDN) - a network designed primarily for data transmission and intended for sharing by many users from many organizations.

Pulse Code Modulation (PCM) - a modulation scheme that samples the information signals and transmits a series of coded pulses to represent the data.

Q.2931 - Derived from Q.93B, the narrowband ISDN signalling protocol, an ITU standard describing the signalling protocol to be used by switched virtual circuits on ATM LANs.

Quality of Service (QoS) - Quality of Service is defined on an end-to-end basis in terms of the following attributes of the end-to-end ATM connection:

Cell Loss Ratio
Cell Transfer Delay
Cell Delay Variation

Queuing Delay (QD) - refers to the delay imposed on a cell by its having to be buffered because of unavailability of resources to pass the cell onto the next network function or element. This buffering could be a result of oversubscription of a physical link, or due to a connection of higher priority or tighter service constraints getting the resource of the physical link.

Radio Frequency Interference (RFI) - the unintentional transmission of radio signals. Computer equipment and wiring can both generate and receive RFI.

Real-Time Clock - a clock that maintains the time of day, in contrast to a clock that is used to time the electrical pulses on a circuit.

Red Alarm - In T1, a red alarm is generated for a locally detected failure such as when a condition like OOF exists for 2.5 seconds, causing a CGA, (Carrier Group Alarm).

Reduced Instruction Set Computer (RISC) - a generic name for CPUs that use a simpler instruction set than more traditional designs.

Redundancy - In a data transmission, the fragments of characters and bits that can be eliminated with no loss of information.

Registration - The address registration function is the mechanism by which Clients provide address information to the LAN Emulation Server.

Relaying - a function of a layer by means of which a layer entity receives data from a corresponding entity and transmits it to another corresponding entity.

Request To Send (RTS) - an RS-232 modem interface signal (sent from the DTE to the modem on pin 4) which indicates that the DTE has data to transmit.

Requests For Comment (RFCs) - IETF documents suggesting protocols and policies of the Internet, inviting comments as to the quality and validity of those policies. These comments are collected and analyzed by the IETF in order to finalize Internet standards.

RFC1483 - Multiprotocol Encapsulation over ATM Adaptation Layer 5.
RFC1490 - Multiprotocol Interconnect over Frame Relay.
RFC1577 - Classical IP and ARP over ATM.
RFC1755 - ATM Signaling Support for IP over ATM.

Robbed-Bit Signaling - In T1, refers to the use of the least significant bit of every word of frames 6 and 12 (D4), or 6, 12, 18, and 24 (ESF) for signaling purposes.

Route Server - A physical device that runs one or more network layer routing protocols, and which uses a route query protocol in order to provide network layer routing forwarding descriptions to clients.

Router - a device that forwards traffic between networks or subnetworks based on network layer information.

Routing Domain (RD) - A group of topologically contiguous systems which are running one instance of routing.

Routing Information Protocol (RIP) - a distance vector-based protocol that provides a measure of distance, or hops, from a transmitting workstation to a receiving workstation.

Routing Protocol - A general term indicating a protocol run between routers and/or route servers in order to exchange information used to allow computation of routes. The result of the routing computation will be one or more forwarding descriptions.

SBus - hardware interface for add-in boards in later-version Sun 3 workstations.

Scalable Processor Architecture Reduced instruction set Computer (SPARC) - a powerful workstation similar to a reduced-instruction-set-computing (RISC) workstation.

Segment - a single ATM link or group of interconnected ATM links of an ATM connection.

Segmentation And Reassembly (SAR) - the SAR accepts PDUs from the CS and divides them into very small segments (44 bytes long). If the CS-PDU is less than 44 bytes, it is padded to 44 with zeroes. A two-byte header and trailer are added to this basic segment. The header identifies the message type (beginning, end, continuation, or single) and contains sequence numbering and message identification. The trailer gives the SAR-PDU payload length, exclusive of pad, and contains a CRC check to ensure the SAR-PDU integrity. The result is a 48-byte PDU that fits into the payload field of an ATM cell.

Selector (SEL) - A subfield carried in SETUP message part of ATM endpoint address Domain specific Part (DSP) defined by ISO 10589, not used for ATM network routing, used by ATM end systems only.

Semipermanent Connection - a connection established via a service order or via network management.

Serial Line IP (SLIP) - A protocol used to run IP over serial lines, such as telephone circuits or RS-232 cables, interconnecting two systems.

Service Access Point (SAP) - the point at which an entity of a layer provides services to its LM entity or to an entity of the next higher layer.

Service Data Unit (SDU) - a unit of interface information whose identity is preserved from one end of a layer connection to the other.

Service Specific Connection Oriented Protocol (SSCOP) - an adaptation layer protocol defined in ITU-T Specification: Q.2110.

Service Specific Convergence Sublayer (SSCS) - The portion of the convergence sublayer that is dependent upon the type of traffic that is being converted.

Session Layer - Layer 5 in the OSI model that is responsible for establishing and managing sessions between the application programs running in different nodes.

Severely Errored Seconds (SES) - a second during which more event errors have occurred than the SES threshold (normally 10-3).

Shaping Descriptor - *n* ordered pairs of GCRA parameters (I,L) used to define the negotiated traffic shape of an APP connection. The traffic shape refers to the load-balancing of a network, where load-balancing means configuring data flows to maximize network efficiency.

Shielded Pair - Two insulated wires in a cable wrapped with metallic braid or foil to prevent interference and provide noise free transmission.

Shielded Twisted Pair (STP) - two or more insulated wires, twisted together and then wrapped in a cable with metallic braid or foil to prevent interference and offer noise-free transmissions.

Signaling System No. 7 (SS7) - The SS7 protocol has been specified by ITU-T and is a protocol for interexchange signaling.

Simple and Efficient Adaptation Layer (SEAL) - also called AAL 5, this ATM adaptation layer assumes that higher layer processes will provide error recovery, thereby simplifying the SAR portion of the adaptation layer. Using this AAL type packs all 48 bytes of an ATM cell information field with data. It also assumes that only one message is crossing the UNI at a time. That is, multiple end-users at one location cannot interleave messages on the same VC, but must queue them for sequential transmission.

Simple Gateway Management Protocol (SGMP) - the predecessor to SNMP.

Simple Mail Transfer Protocol (SMTP) - the Internet electronic mail protocol used to transfer electronic mail between hosts.

Simple Network Management Protocol (SNMP) - the Internet standard protocol for managing nodes on an IP network.

Simple Protocol for ATM Network Signalling (SPANS) - FORE Systems' proprietary signalling protocol used for establishing SVCs between FORE Systems equipment.

Single Mode Fiber (SMF) - Fiber optic cable in which the signal or light propagates in a single mode or path. Since all light follows the same path or travels the same distance, a transmitted pulse is not dispersed and does not interfere with adjacent pulses. SMF fibers can support longer distances and are limited mainly by the amount of attenuation. Refer to MMF.

Small Computer Systems Interface (SCSI) - a standard for a controller bus that connects hardware devices to their controllers on a computer bus, typically used in small systems.

Smart PVC (SPVC) - a generic term for any communications medium which is permanently provisioned at the end points, but switched in the middle. In ATM, there are two kinds of SPVCs: smart permanent virtual path connections (SPVPCs) and smart permanent virtual channel connections (SPVCCs).

snmpd - an SMNP agent for a given adapter card.

Source - Part of communications system which transmits information.

Source Address (SA) - The address from which the message or data originated.

Source MAC Address (SA) - A six octet value uniquely identifying an end point and which is sent in an IEEE LAN frame header to indicate source of frame.

Source Traffic Descriptor - a set of traffic parameters belonging to the ATM Traffic Descriptor used during the connection set-up to capture the intrinsic traffic characteristics of the connection requested by the source.

Spanning Tree Protocol - provides loop-free topology in a network environment where there are redundant paths.

Static Route - a route that is entered manually into the routing table.

Statistical Multiplexing - a technique for allowing multiple channels and paths to share the same link, typified by the ability to give the bandwidth of a temporarily idle channel to another channel.

Stick and Click (SC) - Designation for an Optical Connector featuring a 2.5 mm physically contacting ferrule with a push-pull mating design. Commonly referred to as Structured Cabling, Structured Connectors or Stick and Click

Stick and Turn (ST) - A fiber-optic connector designed by AT&T which uses the bayonet style coupling rather than screw-on as the SMA uses. The ST is generally considered the eventual replacement for the SMA type connector.

Store-and-Forward - the technique of receiving a message, storing it until the proper outgoing line is available, then retransmitting it, with no direct connection between incoming and outgoing lines.

Straight Tip (ST) - see *Stick and Turn*.

Structured Cabling (SC) - see *Stick and Click*.

Structured Connectors (SC) - see *Stick and Click*.

Sublayer - a logical subdivision of a layer.

SubNetwork Access Protocol (SNAP) - a specially reserved variant of IEEE 802.2 encoding SNAP indicates to look further into the packet where it will fine a Type field.

Subscriber Network Interface (SNI) - the interface between an SMDS end user's CPE and the network directly serving the end user, supported by either a DS1 or DS3 access arrangement.

Super Frame (SF) - a term used to describe the repeating 12 D4 frame format that composes a standard (non-ESF) T1 service.

Super User - a login ID that allows unlimited access to the full range of a device's functionality, including especially the ability to reconfigure the device and set passwords.

Sustainable Cell Rate (SCR) - ATM Forum parameter defined for traffic management. For VBR connections, SCR determines the long-term average cell rate that can be transmitted.

Sustained Information Rate (SIR) - In ATM this refers to the long-term average data transmission rate across the User-to-Network Interface. In SMDS this refers to the committed information rate (similar to CIR for Frame Relay Service).

Switch - Equipment used to interconnect lines and trunks.

Switched Connection - A connection established via signaling.

Switched Multimegabit Data Service (SMDS) - a high-speed, datagram-based, public data network service expected to be widely used by telephone companies in their data networks.

Switched Virtual Channel Connection (SVCC) - A Switched VCC is one which is established and taken down dynamically through control signaling. A Virtual Channel Connection (VCC) is an ATM connection where switching is performed on the VPI/VCI fields of each cell.

Switched Virtual Circuit (or Channel) (SVC) - a channel established on demand by network signalling, used for information transport between two locations and lasting only for the duration of the transfer; the datacom equivalent of a dialed telephone call.

Switched Virtual Path Connection (SVPC) - a connection which is established and taken down dynamically through control signaling. A Virtual Path Connection (VPC) is an ATM connection where switching is performed on the VPI field only of each cell.

Switching System - A set of one or more systems that act together and appear as a single switch for the purposes of PNNI routing.

Symmetric Connection - a connection with the same bandwidth specified for both directions.

Synchronous - signals that are sourced from the same timing reference and hence are identical in frequency.

Synchronous Data Link Control (SDLC) - IBM's data link protocol used in SNA networks.

Synchronous Optical Network (SONET) - a body of standards that defines all aspects of transporting and managing digital traffic over optical facilities in the public network.

Synchronous Payload Envelope (SPE) - the payload field plus a little overhead of a basic SONET signal.

Synchronous Transfer Mode (STM) - a transport and switching method that depends on information occurring in regular, fixed patterns with respect to a reference such as a frame pattern.

Synchronous Transport Signal (STS) - a SONET electrical signal rate.

Systeme En Coleur Avec Memoire (SECAM) - Sequential and Memory Color Television - Started in France in the late 60s, and used by other countries with a political affiliation. This is. The B-Y and R-Y signals are transmitted on alternate lines modulated on an FM subcarrier. The memory is a one line delay line in the receiver to make both color difference signals available at the same time on all lines. Due to FM, the signal is robust in difficult terrain.

Systems Network Architecture (SNA) - a proprietary networking architecture used by IBM and IBM-compatible mainframe computers.

T1 - a specification for a transmission line. The specification details the input and output characteristics and the bandwidth. T1 lines run at 1.544 Mbps and provide for 24 data channels. In common usage, the term "T1" is used interchangeably with "DS1."

T1 Link - A wideband digital carrier facility used for transmission of digitized voice, digital data, and digitized image traffic. This link is composed of two twisted-wire pairs that can carry 24 digital channels, each operating at 64K bps at the aggregate rate of 1.544M bps, full duplex. Also referred to as DS-1.

T3 - a specification for a transmission line, the equivalent of 28 T1 lines. T3 lines run at 44.736 Mbps. In common usage, the term "T3" is used interchangeably with "DS3."

Tachometer - in *ForeView*, the tachometer shows the level of activity on a given port. The number in the tachometer shows the value of a chosen parameter in percentage, with a colored bar providing a semi-logarithmic representation of that percentage.

Tagged Cell Rate (TCR) - An ABR service parameter, TCR limits the rate at which a source may send out-of-rate forward RM-cells. TCR is a constant fixed at 10 cells / second.

Telephony - The conversion of voices and other sounds into electrical signals which are then transmitted by telecommunications media.

Telnet - a TCP / IP protocol that defines a client / server mechanism for emulating directly-connected terminal connections.

Terminal Equipment (TE) - Terminal equipment represents the endpoint of ATM connection(s) and termination of the various protocols within the connection(s).

Throughput - Measurement of the total useful information processed or communicated by a computer during a specified time period, i.e. packets per second.

Time Division Multiplexing (TDM) - a method of traditional digital multiplexing in which a signal occupies a fixed, repetitive time slot within a higher-rate signal.

Token Ring - a network access method in which the stations circulate a token. Stations with data to send must have the token to transmit their data.

topology - a program that displays the topology of a FORE Systems ATM network. An updated topology can be periodically re-displayed by use of the interval command option.

Traffic - the calls being sent and received over a communications network. Also, the packets that are sent on a data network.

Traffic Management (TM) - The traffic control and congestion control procedures for ATM. ATM layer traffic control refers to the set of actions taken by the network to avoid congestion conditions. ATM layer congestion control refers to the set of actions taken by the network to minimize the intensity, spread and duration of congestion. The following functions form a framework for managing and controlling traffic and congestion in ATM networks and may be used in appropriate combinations:

Connection Admission Control
Feedback Control
Usage Parameter Control
Priority Control
Traffic Shaping
Network Resource Management
Frame Discard
ABR Flow Control

Traffic Parameter - A parameter for specifying a particular traffic aspect of a connection.

Trailer - the protocol control information located at the end of a PDU.

Transit Delay - the time difference between the instant at which the first bit of a PDU crosses one designated boundary, and the instant at which the last bit of the same PDU crosses a second designated boundary.

Transmission Control Protocol (TCP) - a specification for software that bundles and unbundles sent and received data into packets, manages the transmission of packets on a network, and checks for errors.

Transmission Control Protocol/Internet Protocol (TCP/IP) - a set of communications protocols that has evolved since the late 1970s, when it was first developed by the Department of Defense. Because programs supporting these protocols are available on so many different computer systems, they have become an excellent way to connect different types of computers over networks.

Transmission Convergence (TC) - generates and receives transmission frames and is responsible for all overhead associated with the transmission frame. The TC sublayer packages cells into the transmission frame.

Transmission Convergence Sublayer (TCS) - This is part of the ATM physical layer that defines how cells will be transmitted by the actual physical layer.

Transparent Asynchronous Transmitter/Receiver Interface (TAXI) - Encoding scheme used for FDDI LANs as well as for ATM; supports speed typical of 100 Mbps over multimode fiber.

Transport Layer - Layer Four of the OSI reference model that is responsible for maintaining reliable end-to-end communications across the network.

trap - a program interrupt mechanism that automatically updates the state of the network to remote network management hosts. The SNMP agent on the switch supports these SNMP traps.

Trivial File Transfer Protocol (TFTP) - Part of IP, a simplified version of FTP that allows files to be transferred from one computer to another over a network.

Twisted Pair - Insulated wire in which pairs are twisted together. Commonly used for telephone connections, and LANs because it is inexpensive.

Unassigned Cells - a generated cell identified by a standardized virtual path identifier (VPI) and virtual channel identifier (VCI) value, which does not carry information from an application using the ATM Layer service.

Unavailable Seconds (UAS) - a measurement of signal quality. Unavailable seconds start accruing when ten consecutive severely errored seconds occur.

UNI 3.0/3.1 - the User-to-Network Interface standard set forth by the ATM Forum that defines how private customer premise equipment interacts with private ATM switches.

Unicasting - The transmit operation of a single PDU by a source interface where the PDU reaches a single destination.

Universal Test & Operations Interface for ATM (UTOPIA) - Refers to an electrical interface between the TC and PMD sublayers of the PHY layer.

Unshielded Twisted Pair (UTP) - a cable that consists of two or more insulated conductors in which each pair of conductors are twisted around each other. There is no external protection and noise resistance comes solely from the twists.

Unspecified Bit Rate (UBR) - a type of traffic that is not considered time-critical (e.g., ARP messages, pure data), allocated whatever bandwidth is available at any given time. UBR traffic is given a “best effort” priority in an ATM network with no guarantee of successful transmission.

Uplink - Represents the connectivity from a border node to an upnode.

Usage Parameter Control (UPC) - mechanism that ensures that traffic on a given connection does not exceed the contracted bandwidth of the connection, responsible for policing or enforcement. UPC is sometimes confused with congestion management (see *congestion management*).

User Datagram Protocol (UDP) - the TCP/IP transaction protocol used for applications such as remote network management and name-service access; this lets users assign a name, such as “RVAX*2,S,” to a physical or numbered address.

User-to-Network Interface (UNI) - the physical and electrical demarcation point between the user and the public network service provider.

V.35 - ITU-T standard describing a synchronous, physical layer protocol used for communications between a network access device and a packet network. V.35 is most commonly used in the United States and Europe, and is recommended for speeds up to 48 Kbps.

Variable Bit Rate (VBR) - a type of traffic that, when sent over a network, is tolerant of delays and changes in the amount of bandwidth it is allocated (e.g., data applications).

Virtual Channel (or Circuit) (VC) - a communications path between two nodes identified by label rather than fixed physical path.

Virtual Channel Connection (VCC) - a unidirectional concatenation of VCLs that extends between the points where the ATM service users access the ATM Layer. The points at which the ATM cell payload is passed to, or received from, the users of the ATM Layer (i.e., a higher layer or ATMM-entity) for processing signify the endpoints of a VCC.

Virtual Channel Identifier (VCI) - the address or label of a VC; a value stored in a field in the ATM cell header that identifies an individual virtual channel to which the cell belongs. VCI values may be different for each data link hop of an ATM virtual connection.

Virtual Channel Link (VCL) - a means of unidirectional transport of ATM cells between the point where a VCI value is assigned and the point where that value is translated or removed.

Virtual Channel Switch - a network element that connects VCLs. It terminates VPCs and translates VCI values. The Virtual Channel Switch is directed by Control Plane functions and relays the cells of a VC.

Virtual Connection - an endpoint-to-endpoint connection in an ATM network. A virtual connection can be either a virtual path or a virtual channel.

Virtual Local Area Network (VLAN) - Work stations connected to an intelligent device which provides the capabilities to define LAN membership.

Virtual Network Software (VINES) - Banyan's network operating system based on UNIX and its protocols.

Virtual Path (VP) - a unidirectional logical association or bundle of VCs.

Virtual Path Connection (VPC) - a concatenation of VPLs between virtual path terminators (VPTs). VPCs are unidirectional.

Virtual Path Identifier (VPI) - the address or label of a particular VP; a value stored in a field in the ATM cell header that identifies an individual virtual path to which the cell belongs. A virtual path may comprise multiple virtual channels.

Virtual Path Link (VPL) - a means of unidirectional transport of ATM cells between the point where a VPI value is assigned and the point where that value is translated or removed.

Virtual Path Switch - a network element that connects VPLs, it translates VPI (not VCI) values and is directed by Control Plane functions. The Virtual Path Switch relays the cells of a Virtual Path.

Virtual Path Terminator (VPT) - a system that unbundles the VCs of a VP for independent processing of each VC.

Virtual Private Data Network (VPDN) - a private data communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

Virtual Private Network (VPN) - a private voice communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

Virtual Source/Virtual Destination (VS/VD) - An ABR connection may be divided into two or more separately controlled ABR segments. Each ABR control segment, except the first, is sourced by a virtual source. A virtual source implements the behavior of an ABR source endpoint. Backwards RM-cells received by a virtual source are removed from the connection. Each ABR control segment, except the last, is terminated by a virtual destination. A virtual destination assumes the behavior of an ABR destination endpoint. Forward RM-cells received by a virtual destination are turned around and not forwarded to the next segment of the connection.

Virtual Tributary (VT) - a structure used to carry payloads such as DS1s that run at significantly lower rates than STS-1s.

Warm Start Trap - an SNMP trap which indicates that SNMP alarm messages or agents have been enabled.

Wide-Area Network (WAN) - a network that covers a large geographic area.

Wideband Channel - Communications channel with more capacity (19.2K bps) than the standard capacity of a voice grade line.

X.21 - ITU-T standard for serial communications over synchronous digital lines. The X.21 protocol is used primarily in Europe and Japan.

X.25 - a well-established data switching and transport method that relies on a significant amount of processing to ensure reliable transport over metallic media.

Yellow Alarm - An alarm signal sent back toward the source of a failed signal due to the presence of an AIS (may be used by APS equipment to initiate switching).

Zero Byte Time Slot Interchange (ZBTSI) - A technique used with the T carrier extended superframe format (ESF) in which an area in the ESF frame carries information about the location of all-zero bytes (eight consecutive “0”s) within the data stream.

Zero Code Suppression - The insertion of a “1” bit to prevent the transmission of eight or more consecutive “0” bits. Used primarily with T1 and related digital telephone company facilities, which require a minimum “1’s density” in order to keep the individual subchannels of a multiplexed, high speed facility active.

Zero-Bit Insertion - A technique used to achieve transparency in bit-oriented protocols. A zero is inserted into sequences of one bits that cause false flag direction.

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